# THE AMERICAN LAND

Western American primeval forest, an excellent example of what western American land looked like in the beginning, photographed by Joseph Dixon in the back country of the Yosemite. The trees behind the deer are Douglas firs.

# THE AMERICAN LAND

## ITS HISTORY AND ITS USES

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TO

JOHN M. MORRISON

who from the vantage point of his armchair

came to know and understand

the American land

# PREFACE

This is a simple story about American land and how it is used. I wrote it because it has been my experience that looking at the land can become pretty dull fare unless you know something about what you are seeing. And, as far as I know, there is no place where you can find material of that sort unless you are willing to read a great many other books, many of them highly technical.

To a very large number of people, the only 'scenery' of any interest is that of spectacular mountain landscapes, more particularly of the western United States; and it is true that there can be nothing more wonderful anywhere than the superb and exhilarating views in many of our great National Parks and Forests. But in between the spectacular places are enormous areas of land no less interesting because what they have to tell is not understood by everyone. Actually, the dullest landscape may have a story back of it packed with drama and human interest out of all proportion to its apparently ordinary appearance.

Anywhere in the world the face of the land faithfully reflects the culture of the people who live upon it. Where the land is poor and worn, so are the people who strive to maintain themselves on its inhospitable surface. And where the land is rich and bountiful, the people who inhabit it have an opportunity to live a rich and bountiful life

Sir Reginald George Stapledon expressed this whole idea in a nutshell not long ago, in a book about the land of England:

> The culture of a nation [he wrote] by general consent, would, I suppose, be regarded as its greatest heritage, but a heritage perhaps equally worthy of being cherished is the land surface which a

nation occupies. The culture to a large extent must have been influenced by the character of the land surface, and in any event culture and land surface are interwoven, and interact in countless directions difficult to unravel.

For better or for worse a nation may endeavour to mould and to develop its culture along definite and preconceived lines. In whatsoever direction the national character and the nation's activities move, the land surface and the use to which it has been, and is being, put, will be the mirror which reflects the devious paths which a people have trodden in search of self expression.*

The chances are remote that any American is likely ever to know all there is to know about America. But spread out to read, if he can, on the land of the United States is the story of a great nation, of its people, of their goings and comings, their food, their dress, their attitude of mind, their ways of living. The deceivingly simple arrangement of farm fields, the diversity of crop plants, the appearance of pastures, the condition of woodlands, the gullies that go with extravagance, the terraces bespeaking conservation, the very direction the plow furrows take—these things and others like them are bits of a great pattern with a living meaning. Pieced together and interpreted correctly they furnish a commentary on America more accurate than all the histories ever written. This book cannot tell the whole story of American land, but it is the author's sincere hope that it may help people to understand what they see.

I have used a great many books in preparing this one Some of them are mentioned by name in the text itself, but there are others that should be listed here, both because they have been of such great help to me, and because others may find them interesting companion reading. I can commend all of them highly.

Hjalmar R. Holand's admirable book *Westward From Vinland*,

* *The Land—Now and Tomorrow* by Sir Reginald George Stapledon, Faber and Faber Ltd. Revised Edition, London, 1941.

published in 1940, supplied the basis for the opening paragraphs of the first chapter. Duell, Sloan and Pearce kindly permitted quotations from Mr. Holand's work, which appeals to me as the most interesting story of its kind in print.

Writing the first chapter took a long time and a great deal of consultation with journals and diaries of early explorers. Reuben Gold Thwaite's excellent set of books on *Early Western Travels* supplied an abundance of material on America as it was in the beginning. I am indeed grateful to the Arthur H. Clark Company for permission to use several pertinent quotations from these books, which contain what I have found to be one of the most complete collections of early accounts of this country ever printed. The same company also granted my request to reprint some of Archer Butler Hulbert's remarks from *Historic Highways of America*, on the way in which buffalo marked out many American roads. Mrs. Woodrow Wilson kindly gave permission to reprint the comments of a captain of one of Sir Walter Raleigh's vessels from *A History of the American People* by Woodrow Wilson. Likewise, the Trustees of the Theodore Roosevelt Estate accorded permission for the excerpts from Roosevelt's *Winning of the West*. Finally, the Houghton Mifflin Company permitted the use of a portion of the chronicle of the Castañeda expedition from Walter Prescott Webb's *The Great Plains*.

Most of the chapter on 'The Mystery and the Mastery of Corn' I have already published, and I am indebted to my good friend Wellington Brink for permission to reproduce this material from *Soil Conservation* magazine, of which he is editor.

The excellent McGraw-Hill publications in the agricultural and botanical sciences include a number from which I have drawn liberally. Albert F. Hill's *Economic Botany*, published in 1937, contains a substantial amount of data concerning origins and uses of crop plants. I count it a valuable addition to any library. *Cotton*,

by H. B. Brown, in the same series and appearing in 1938, provided a fertile source for the chapter on cotton. Similarly *Truck Crop Plants*, by H. A. Jones and J. T. Rosa, helped to prepare Chapter 9 dealing with that general subject, as did the third edition of Homer C. Thompson's *Vegetable Crops*, published in 1939. Hutcheson, Wolfe and Kipps's *The Production of Field Crops* was of particular value in writing about grains and legumes.

Two outstanding books on agriculture, of course, are the *Yearbooks of Agriculture* for 1936 and 1937. These volumes contain an astonishing amount of material on the breeding of all kinds of crop plants, interspersed with a great deal of interesting reading on their origins, and history. I know of nothing more complete.

The Brookings Institution *Reports on the National Park Service*, and the *Bureau of Biological Survey*, both prepared by Jenks Cameron, were invaluable aids in developing the chapter on 'Land for Wildlife and Recreation.' These books look a bit formal but they are well-written and highly interesting. Permission to quote from them was kindly accorded by Brookings.

The two last chapters on erosion and soil conservation relied for much of their material on that most authoritative work *Soil Conservation*, by Hugh H. Bennett, outstanding leader in the field of conservation. The culmination of a fruitful public career in soils work, this book will long remain *the* book on a subject of great importance in America as well as the rest of the world.

For the pictures I am indebted to bureaus in the United States Departments of Agriculture, as follows:

The Soil Conservation Service supplied the photographs for Plates 3 to 5, 10, 22, 44, 46 to 51 and 56 to 64; the upper pictures in Plates 2, 11, 23, 27, 35, 39 and 45, and the lower pictures in Plates 8, 9, 13, 14, 16, 18, 19, 29, 33, 43, and 54. The upper picture in Plate 60 is used by courtesy of the 41st Division of Aviation, Washington National Guard.

The Extension Service supplied the photographs for Plates 15, 17, 24 to 26, 31, 32, 37, 38, 40 and 42; the upper pictures in Plates 8, 9, 13, 14, 18, 19, 30, 33, and 34; and the lower pictures in Plates 6, 7, 20, 21, 23, 27, 28, 35, 39, 45, and 52.

The Agricultural Adjustment Administration supplied pictures for Plates 12 and 41; the upper pictures in Plates 6, 20, and 43; and the lower picture in Plate 11. The Farm Credit Administration supplied the upper picture in Plate 7; the Forest Service, the picture in Plate 1; the Bureau of Entomology and Plant Quarantine, the boll weevil photograph in Plate 12; The Farm Security Administration, the upper picture in Plate 16; and the Bureau of Plant Industry, the pictures in Plate 36, the upper pictures in Plates 28 and 29, and the lower pictures in Plate 30.

The National Park Service of the Department of Interior kindly supplied the frontispiece photograph, Plate 55, and the upper picture in Plate 54. In the same Department, the Fish and Wildlife Service provided the photographs for Plate 53, the upper picture in Plate 52, and the lower picture in Plate 2.

To Dr. Edward H. Graham I am, as usual, indebted for critical and very helpful suggestions about the content. Also Mr. Charles R. Enlow helped me to correct the agronomic material with which he is so well acquainted. Miss Mabel Bennett did me the great service of editing the manuscript and of correcting many weak spots. Miss Lydia Bernhardt typed most of the manuscript, and for her generous help I am very grateful.

Finally, to all those farmers around the country with whom I have talked and through whose eyes I have seen much more than I thought possible, I offer my appreciation of their patience and my admiration for their wisdom. Sometimes I think they know more about America than anyone else.

W.R.V.D.

Washington, D. C.,
*February* 7, 1943.

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# THE AMERICAN LAND

## I

# THE LAND IN THE BEGINNING

As far as anyone knows, the first white man ever to set foot on any part of the land now included within the United States was that remarkable Viking adventurer, Leif the Lucky. It was almost a thousand years ago, according to the historical record, that 23-year-old Leif Erikson and his company of 35 hardy Norsemen landed somewhere on the shores of New England, in all probability in Massachusetts. They arrived in the autumn of A.D. 1003, and along the shores the fruiting heads of a wild-rice or wild-rye nodded in the gentle winds. It seemed to them a beautiful country, according to the account, well-timbered, and pleasant to see.

Leif and his men put up temporary sheds, and later on they built large houses in which to spend the winter. With everything ship-shape, half the men were dispatched each day to explore the neighboring country, with strict instructions to return by nightfall and above all not to separate. But one evening Tyrk, Leif's foster-father, failed to return. The distressed leader promptly began a search that ended almost as soon as it had started. Tyrk was found, and in very high spirits.

'I found something new to report,' declared he, 'I found grapevines and grapes!'

'Can that be possible, foster-father?' exclaimed Leif.

'It certainly is true,' answered Tyrk, 'for I was born where there was no scarcity of grapevines or grapes.'

And so, the sagas say, when spring came they sailed away with a

favorable wind. And Leif named the land after its special product and called it Vinland.

For many years after this, Norsemen cut and shipped timber from the great forests of the western world to their homes in Greenland, which is closer to North America than to Europe. There seem to have been repeated attempts at settlement, at least some of which failed because of hostile Indians. Finally in 1362, just 130 years before Columbus reached the West Indies, came the last of the Norsemen. About that time Paul Knutson is believed to have sailed along the northern shore of Labrador, into Hudson Bay, around its southern shores to the Nelson River, and south through Lake Winnipeg and the Red River to Douglas County, Minnesota. There the party left the famed Kensington Stone, and then disappeared forever, perhaps wiped out by savages, or perhaps in part assimilated by the Mandan Indians of the Dakotas.

But the history of the United States would have been no different had Leif Erikson or Paul Knutson never set sail. The moment was not yet; Europe was not ready to invade another world, nor for that matter, to accept the fact of a western continent. Not until Columbus returned to Spain with his remarkable tales of the Indies did the train of events start into motion that was to establish a civilization in the New World. Not Columbus, but *Johanno Caboto, almost mythical figure,* landed next after the Norsemen on what is now United States soil. And then Cortereal and Ponce de León, Verrazano, Gomez, Narváez, Coronado, De Soto, and all the rest.

What America looked like when the earliest explorers and settlers first saw it is by no means clear from the meager records they left. A full account would be a priceless document now. *But who, indeed, might suspect that those who were to come* later would be interested in a wilderness that was an obstacle to be conquered *rather than described?*

No one man, of course, could have written about the land of the United States because it was discovered only bit by bit over several centuries. But if the story could have been assembled as exploration proceeded, it might well have started with the Atlantic shores and finished with the Far West. And so, to see America as it might have been, let us try to do the same.

## The Forests of the East

It is curious that the discoverers of Virginia should have been impressed, as were the Vikings, with the grapevines to be found on the new shores. The captain of one of Sir Walter Raleigh's vessels wrote in 1584,

. . . we viewed the land about us, being, wheras we first landed, very sandie and low towards the waters side, but so full of grapes, as the very beating and surge of the Sea overflowed them, of which we found such plentie . . . both on the sand and on the greene soile on the hils, as in the plaines, as well on every little shrubbe, as also climing towards the tope of high Cedars, that I thinke in all the world the like abundance is not to be found . . .

But, like the Vikings, the discoverers of Virginia were standing only at the edge of a forest so vast and so magnificent as to be almost inconceivable. It presented a solid front from Maine to Florida and covered nearly all the land from the seacoast to Illinois. There it was divided by a spearhead of prairie into two massive arms, one of which extended north and west to the edge of North Dakota, the other south and west to the center of Texas. It covered all the great Appalachian mountain-system, and encompassed the Great Lakes. Along the Gulf of Mexico it reached almost to the western boundary of Texas. And from its interior side, next the prairie, it sent a thousand narrow strips of forest fingering still further westward along the streams and rivers

of the central grassland. Land there was, in plenty, provided with unbelievably fertile soil, but possession was with the trees.

The identity of the trees that composed the great forest we know with certainty. All but a species or two have survived to the present day, and from the precise and exhaustive surveys made by recent botanists we know now fairly well what the forest composition and range must have been. We know that slash, loblolly, and longleaf pines dominated the forest on drier lands in the Southeast. On lower, wetter land in between occurred moss-draped cypresses, magnolias, and live oaks. In the central East magnificent oaks, chestnuts, hickories, and tulip-poplars composed the bulk of a deciduous forest, merging imperceptibly into beech, birch, maple, and hemlock, further north (Plate 1). In the alluvial valleys of this type were to be found walnuts, butternuts, ash, and the gigantic sycamores with splotched bark. High in the mountains or in parts of the extreme North, white, Norway, and jack pines or spruce and balsam fir occupied the land, mixing with other forest types as topography and climate demanded.

The composition of the various parts of the Atlantic forest can still be determined from the scraps of it left in isolated and remote places in eastern America. It is much less easy to visualize the grandeur and majesty of the trees themselves. Scores of record heights and diameters, to be sure, are to be found in almost any county history. Heights of 100, 150, 200, and even 250 feet are listed; so are diameters of 8, 10, 15, and even 18 feet. It appears reasonable to assume, as many botanists have, that few trees were measured unless they attracted attention by really gigantic size. Because of this, it is believed that trees 100 feet tall and upwards of 6 feet in diameter must have been common. It is well to remember that *nearly all* the trees were large, over vast areas, not just an occasional specimen.

There is a record of a cypress in South Carolina that was more than 13 feet in diameter; on its stump 17 men sat down to dine after it was felled. A white oak in New Jersey reached 11 feet 3 inches in diameter and measured 59 feet to the first fork. From it were made, the record says, and sold in Philadelphia, 40,000 merchantable barrel staves. One traveler reports crossing a river in Maryland on a scow or canoe made of a single basswood tree. He was accompanied by six other men and four horses, and he supposed it would have carried double this number.

Beneath the great trees was a galaxy of shrubs and lesser trees. Grapes and other vines clambered in snarled tangles on the edges of open places, or hung rope-like from the trees. The forest floor was strewn with fallen trees and rotting branches and covered with a host of lesser plants and heavy mosses. Hundreds of centuries of growth and decay had resulted in a lush soil of remarkable fertility and capable of holding water as does a sponge. Because of this, great swamps and morasses existed where none are known today.

Up to the door sills of the log-huts stretched the solemn and mysterious forest [wrote Theodore Roosevelt in 1894]. The great trees towered aloft till their separate heads were lost in the mass of foliage above, and the rank underbrush choked the spaces between the trunks . . . The sunlight could not penetrate the roofed archway of murmuring leaves . . . All the land was shrouded in one vast forest. It covered the mountains from crest to river-bed . . . and stretched in sombre and melancholy wastes toward the Mississippi. All that it contained, all that lay hid within it and beyond it, none could tell; men only knew that their boldest hunters, however deeply they had penetrated, had not yet gone through it, though it was the home of the game they followed and the wild beasts that preyed on their flocks, and that deep in its tangled depths lurked their red foes, hawk-eyed and wolf-hearted.

Roosevelt gives us a somewhat gloomier picture of the wilderness than do other writers. Yet, he has captured and recorded the fear of it that men felt and the mystery that shrouded its depths, although his account was written long after the time it described. Certainly, present-day remnants of eastern virgin forest, if they are of any size, are indeed somber.

The forest was broken in many ways, by rivers and lakes, by the small clearings of Indians, by game trails, and by burns resulting from fires set by lightning or by the Indians. This last point is of some interest, incidentally, for it is known that the savages burned great areas of forest to make hunting easier. In a sense therefore, as we shall see, not all the forest found by pioneers was virgin forest.

### The Prairie

More and more frequently, as the plains were approached, the western portions of the forest were broken by small, then large stretches of prairie. An early traveler in Ohio complained that a loaded horse could not force its way through the forest he was in. 'I found such a difficulty,' said he, 'in leading my horse . . . through this part of the forest, that I called out to the party . . . to stop till I could see them or I should never see them more; at that time I could not be more than fifteen yards behind them.' But, 'we soon got into a fine open wood, where there was room to drive a coach and six. Soon after we came into extensive meadows, and I was assured that those meadows continue for a hundred and fifty miles . . .'

Finally the forest gave way altogether to open prairie that extended as far as halfway across the Dakotas, and most of the way across Nebraska, Kansas, and Oklahoma. A rich land, this, now forming most of our great corn and wheat belts. No trees, except in the river bottoms and low spots, but waving grass, waist to

head high in good years, as far as the eye could see. Flat or gently undulating grassland across which the winds blew warmly in the summer, creating ripples and waves in the ocean of grass that swept to the horizon miles away.

But the prairie was not all grass. Early comers found vast expanses of flowers that tinged the prairie with blue, pink, red, and yellow from season to season. Set in the soft green or gold of the grass were annuals, biennials, and perennials in numbers so great as to remind pioneers of great flower gardens. Lovely country, but now nearly gone.

'In an agricultural point of view,' wrote John Bradbury, naturalist, 'the vast tract of prairie extending through all these regions, is an important object of consideration . . . Mr. Brackenridge says it cannot be cultivated . . . If I may be permitted to judge from traveling nearly five hundred miles through it, I must pronounce the soil to be excellent, and in almost every part where I saw it in a state of nature, it was covered with the finest verdure imaginable . . . My own opinion is, that it can be cultivated; and that, in process of time, it will not only be peopled and cultivated, but that it will be one of the most beautiful countries in the world.' This in 1810, over 130 years before the prairie became perhaps the greatest agricultural area in the United States.

## The Great Plains

Halfway across the Dakotas, and more or less on a line with this southward, the character of the prairie changes. East of that line, which coincides approximately with the 100th meridian, the grass was tall; westward to the mountains it was short—inches rather than feet in height—and in dry years, very short indeed. This western half of the American plain is what people were talking about prior to 1870 when they spoke of the Great American Desert.

Such, to most explorers, was this short-grass land. Trackless

desert, they said, sand hills, waterless wastes, dreary stretches of cactus, a dry and barren place fit only for the 'jackal.' Central Kansas and Nebraska, people believed, marked the limit beyond which civilization could not go. Even Thomas Jefferson reported to Congress in 1803 that settlements in the Louisiana Territory, which included part of the short-grass country, were separated from each other by immense and trackless deserts. And when Lewis and Clark started across country in 1805, people generally believed that they might find the Lost Tribes of Israel somewhere in the west.

But there were other points of view. For instance:

> Who could believe that 1,000 horses and 500 of our cows and more than 5,000 rams and ewes, and more than 1,500 friendly Indians and servants, in traveling over those plains, would leave no more trace where they had passed than if nothing had been there . . . *The grass never failed to become erect after it had been trodden down, and although it was short, it was as fresh and straight as before.*

The italics are the present author's; the quotation is from Castañeda, chronicler of the Coronado expedition directed by the first of all white men to get into the Great Plains.

Obviously travelers were seeing different things, and from what we have learned of the arid plains we suspect that Coronado visited them in a wet year and that other travelers crossed them in dry years. We know now that a desert climate periodically covers the southern Great Plains at the same time that an arid climate covers the northern portions, and when this happens the Great Plains suffers. It is possible, too, that many explorers, accustomed to the lush vegetation of the East, whence most had come, were not able to adjust themselves to the dry, short-grass country where grama and buffalo grass occupy the land. However, both reports

were right. In good years the grass is excellent; in bad years it is hard to find (Plate 2).

However, during the closing 30 years of the 1800's farmers began to move in considerable numbers into the plains country, where they have held on ever since. They tried to plow it, and reaped dust storms of unprecedented violence. They put too many cattle on it, and lost all they had in dry years when the grass burned down. Only slowly, with great pain and after terrible hardship, has man begun to learn how to live on the Great American Desert.

### The Rockies, Great Basin, and Desert

In the Great Plains the climate is dry some of the time and wet some of the time, but in the mountain plateaus and valleys between the Rockies and the Cascade-Sierra Nevada Mountains the climate is perennially dry. The arid region, it is called by geographers, and except for the high mountains and narrow river edges, the country is indeed dry country.

In its southern portion, this region is a true desert. At one time it was provided with a fair cover of grass, but this has long since been eaten up by excessive numbers of livestock. In the meantime, the cacti and desert shrubs appear to have increased to a considerable extent at the expense, one might say, of the grass. The land sticks through its clothing of sparse vegetation so that rock, gravel, and sand give character to the landscape perhaps more than the plants that grow on it.

The famous sahuaro cacti occur in the southernmost parts of the desert. Sixty feet high, weighing as much as eighty tons, these fantastic trunks rear themselves from a waste of sand and gravel in a manner inconceivable to those who have never seen them. Between them occur lesser cacti, such as the cholla or jumping cactus with its fantastic devilish spines, and a host of wiry, spiny, hairy or greasy shrubs. Here occurs the creosote bush, the palo-

verde, the mesquite, the paloblanco, the ocotillo, and in clumps, the flat-jointed opuntias or prickly-pear cacti. As the climate becomes drier southward, the distance between the shrubs and cacti increases, so that in some places plants may come out of the ground 10 to 15 feet apart. In between, the rocky sand is bare (Plate 3).

If and when it rains, the desert blooms. Within a short time after the water starts the dormant seeds into activity, great sheets of yellow, red, blue, or purple flowers paint the landscape. Poppies, owl-clovers, and a host of tiny plants so rare as to be entirely without any name but their Latin one appear in incredible profusion. Some may be no more than a half-inch tall and may support a single glowing bloom of relatively enormous size. All of them bloom, set seed, and wither in a matter of days, to disappear again until the next rain, biding their time as seeds. With them many of the cacti may bloom, incredibly lovely in soft red and yellow pastel shades.

And so it has always been, except that in primeval times there was much more grass and more flowers. Areas fenced from cattle show this clearly by their recovery. There were fewer cacti—in numbers that is—and relatively fewer shrubs, but at least some of the southern arid country looks much the same today as it has for centuries. To the analytical eye of the range specialist, there are many differences in quantity of grass, in composition of the vegetation, and in the appearance of many weedy herbs and shrubs that were formerly confined within narrower limits or that have come in from other countries. But there are still some areas preserved against use except as parks, where nearly original conditions can be seen.

The northern portions of the arid region are what most people call sagebrush country, because of the seemingly endless stretches covered by that shrub. Some scientists believe this area was once

well grassed and that the sagebrush was confined to draws and low places. Others claim sagebrush was always dominant. Early photographs, it is true, reveal much more grass, and some show plenty of sagebrush also. In any case, sagebrush and grass alike were far more luxuriant before the cattle and sheep came than they are now.

In the mountains timber appears, sparse and scrubby at first, but magnificent at great heights and in the North. In the southern country, oaks, pinyon pines, and junipers clothe the hills and mountains. Northward (and at very high elevations in the South) these trees give way to open forests of yellow pine, and eventually to western white pine, firs, and spruces. There are many areas of forest in the northern Rockies that are still in virgin condition. They are more open than the forests we come now to describe for the Pacific area, but in many other ways they resemble these.

## The Pacific Coast

The heaviest forests in the United States, containing by far the most gigantic trees in the entire world, occurred along the Pacific coast (Frontispiece). Large areas of these maritime forests, even at this writing, still exist almost the same as in prehistoric times. This section of the country, at least the northern part of it, was the last to be settled, and is still nearest to its original condition even though changing at an express-train speed.

Heavy rain and a mild climate combine here to produce vegetation that is no less luxuriant in its highest expression than the tropical rain forest. It is in this area that the colossal California big tree attains its immense bulk. Here too the California redwood reaches heights of 300 to 350 feet. Similarly the great Douglas firs reach heights of 300 feet and diameters of 12 feet, entitling them to be called the third largest trees in the United States. Sitka spruce, western hemlock, arborvitae—all giants associated in a

forest of gigantic proportions—complete the list of more important trees (see also Plate 49).

Undergrowth was, and is, less dense than might be expected. Great sword ferns with fronds 3 to 6 feet long may, in some places, form the only 'underbrush.' Heavy mosses, clinging in mats a foot thick to lower branches, are sometimes abundant. In places there is no understory of plants whatever, merely a soft cushion of needles and twigs, springy to step on, rotting to rich soil beneath. Trees are close together, even so close occasionally as to prevent passage between.

. The earliest settlers in this country seem to have entered on their job of clearing land with mixed feelings. Alexander Ross, who was with the first settlers at Astoria, Oregon, in 1811, had this to say:

The magnificent forest darkened the landscape as far as the eye could reach . . . The place selected for the emporium of the West might challenge the whole continent to produce a spot of equal extent presenting more difficulties to the settler; studded with gigantic trees of almost incredible size, many of them measuring fifty feet in girth, and so close together and intermingled with huge rocks, as to make it a work of no ordinary labour to level and clear the ground . . .

There is an art [continued Ross] in felling a tree, as well as in planting one; but unfortunately none of us had learned that art, and hours together would be spent in conjectures and discussions; one calling that it would fall here; another, there; in short, there were as many opinions as there were individuals about it; and at last, when all hands were assembled to witness the fall, how often we were disappointed! The tree would still stand erect, bidding defiance to our efforts, while every now and then some of the most impatient or fool-hardy would venture to jump on the scaffold and give a blow or two more. Much time was often spent in this desultory manner, before the mighty tree gave way; but it seldom came to the ground. So thick was the forest, and so close the trees

together, that in its fall it would often rest its ponderous top on some other friendly tree; sometimes a number of them would hang together, keeping us in awful suspense, and giving us double labour to extricate the one from the other, and when we had so far succeeded, the removal of the monster stump was the work of days. The tearing up of the roots was equally arduous, although less dangerous; and when this last operation was got through, both tree and stump had to be blown to pieces by gunpowder before either could be removed from the spot . . . Nearly two months of this laborious and incessant toil had passed, and we had scarcely yet an acre of ground cleared.

In the northern Pacific area, the forest conditions described held true from the coast to the crest of the Cascades. As one went southward, the climate slowly became drier—in the summertime—and the dense, heavy forest of conifers gave way gradually to more open woodland made up of oaks, Oregon-myrtle, incense-cedar, madrone, and a greater profusion of shrubs. Beyond the San Francisco Bay region, the big forest disappeared altogether, and the land became covered with chaparral. This is a dense scrubby mass of low trees such as oaks, madrone, and buckeye, and a unique variety of shrubs such as ceanothus, manzanita, chamise, and the like. Some botanists believe that the chaparral was formerly forest, or at least better provided with taller trees than it is now.

Across the top of Washington the heavy forest of conifers would be continuous were it not for one slight gap. Crossing this and proceeding into Idaho, the traveler finds the forest to have changed its composition but to be similar still to the coniferous forest behind him. The trees are western larch—the 'deciduous evergreen'—and western white pine, whose tall straight boles provide such famous timber.

Such, in very general résumé, was the land's appearance in the beginning. Nearly everywhere the new land was well clothed with lush vegetation—forest, grass, or desert shrub. It possessed soil of

unbelievable fertility and productiveness. And it was capable, we now believe, of supporting a population of perhaps 200 million people. Truly, this was a land of promise.

## The Life on the Land

Anyone would suspect that a land as rich as America might well have supported a heavy population of Indians. And some historians would have us believe this was so. But painstaking research by scientists has disclosed that probably not more than 850,000 Indians inhabited the territory that is now the United States. Such a number is about equal to the population of a good-sized, present-day city. Spread out over so vast an area, the density of people in any one place was certainly very light.

It is generally held that the American Indians did not affect the landscape noticeably except here and there. These people, however—at least many of the tribes—had an agriculture that resulted in local, and sometimes appreciable, changes in the condition of the land. The tribes of the eastern United States generally lived in settled villages and maintained fields of corn, squashes, tobacco, and in the South, melons, sweet potatoes and gourds. These fields were to be found most commonly along the fertile river bottoms, but they were by no means confined to such places. Their size has been a matter of some debate, but on good authority they are described as being often 20 to 100 or 200 acres in extent.

In his book on *Beginnings of Agriculture in America*, Lyman Carrier discusses these Indian fields in some detail, pointing out that it might have taken a generation of settlers to have cleared the land as well as they found it, at least in certain localities. He ascribes the success of many early colonies to the fact that they were able to use the Indian clearings immediately upon arrival. Carrier quotes several early colonists who estimated that certain

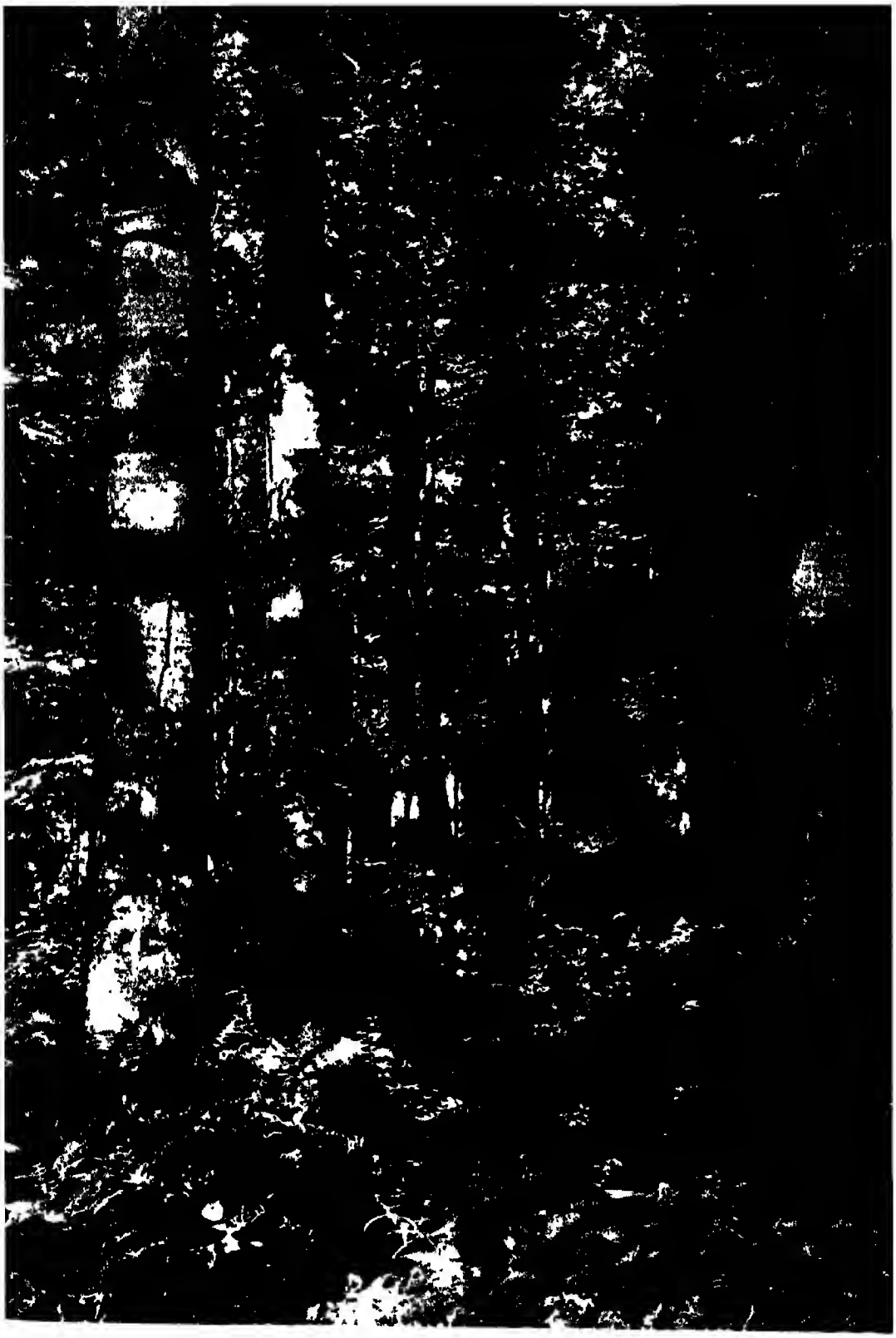

PLATE 1. The interior of a portion of the great eastern American forest. Virgin forests like this covered enormous areas of land now cleared and devoted to agriculture. The trees are beech (left) and sugar maple (right).

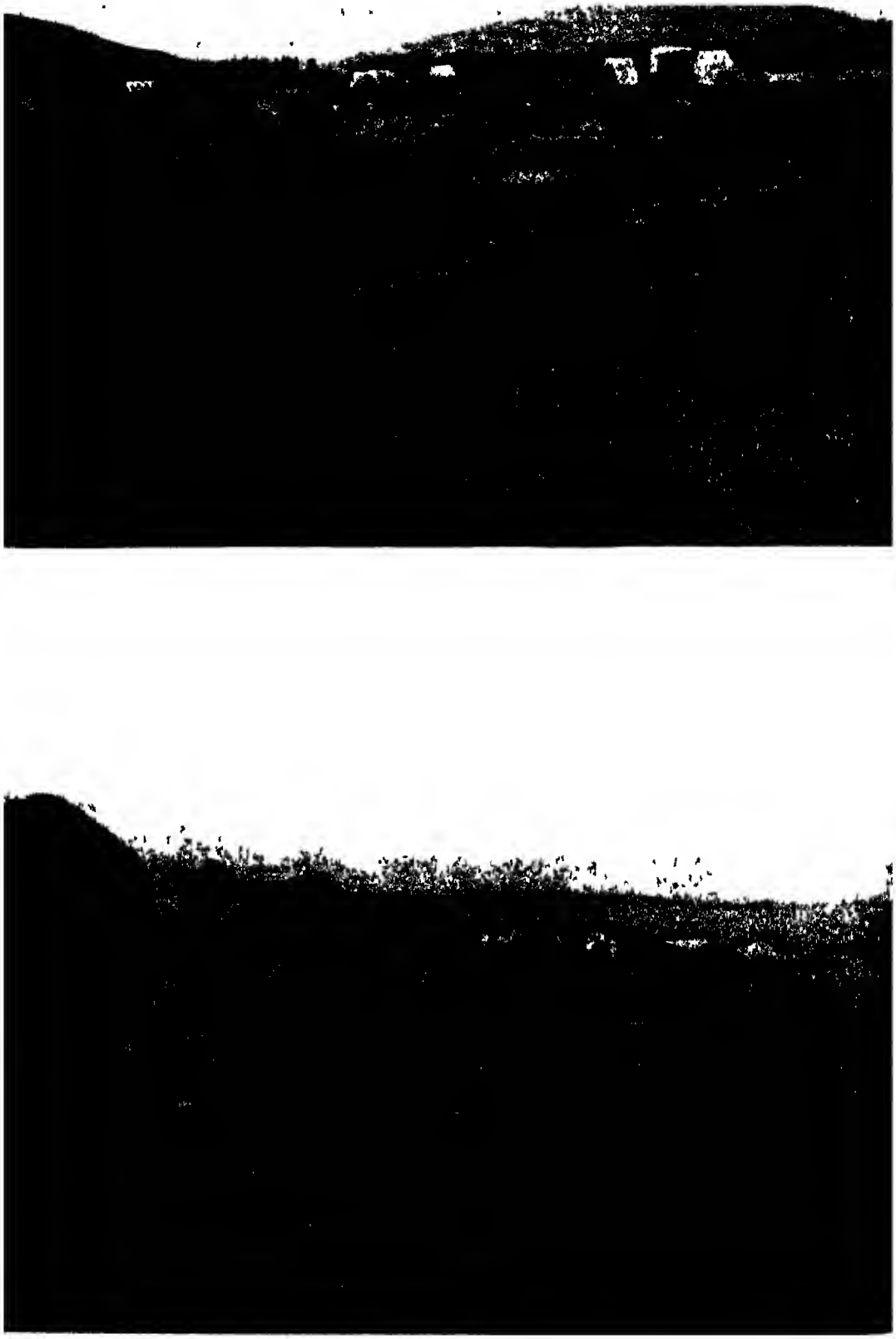

PLATE 2. Virgin grassland photographed in 1870 by W. H. Jackson of the Hayden expedition, in Wyoming. The grass is western wheatgrass.

PLATE 3. American land in the Southwest in virgin condition. The big cactus is a sahuaro; the little branched one in the foreground is a cholla or jumping cactus. Note the bare

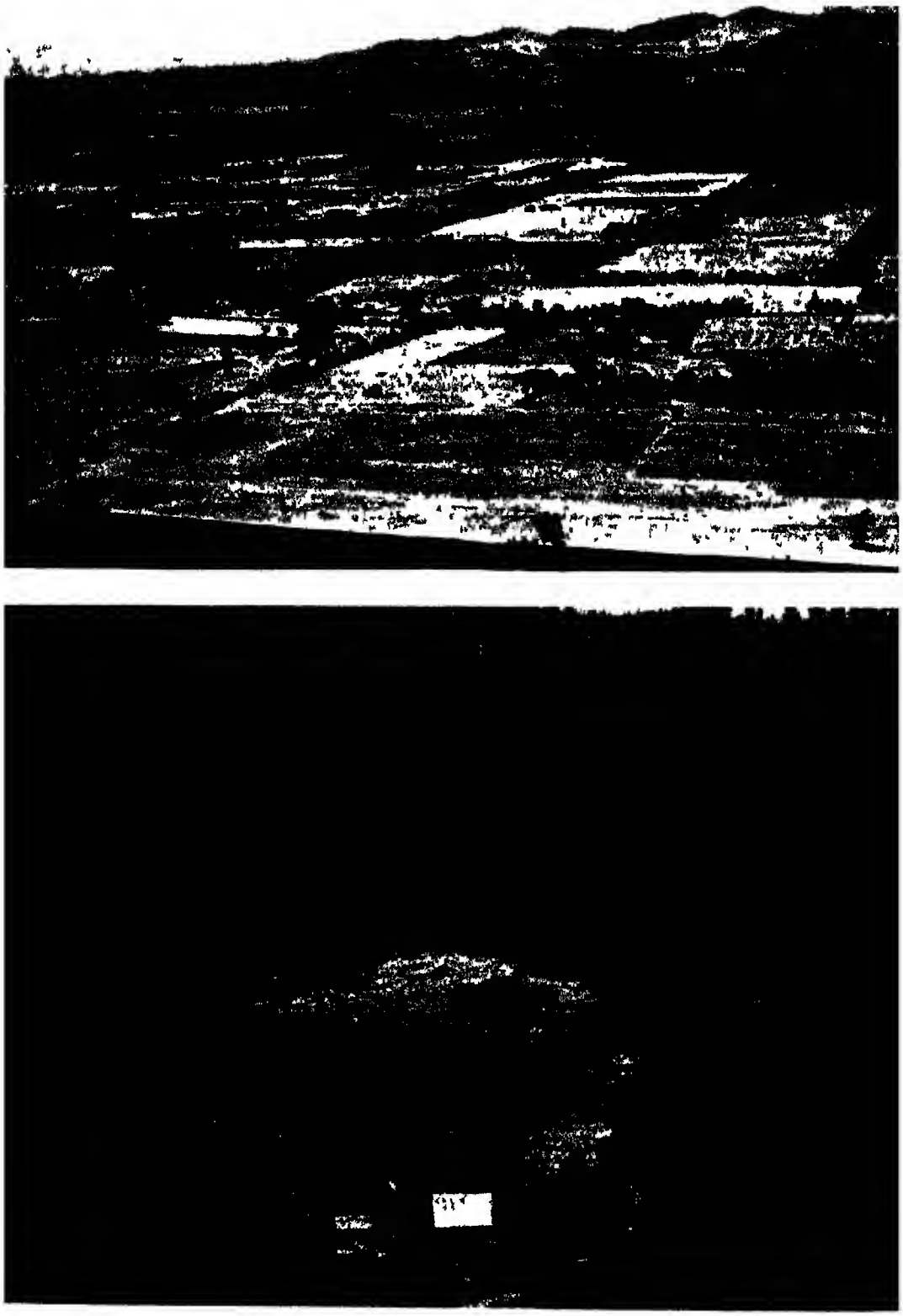

PLATE 4. The land pattern as it has developed in a forested region. The farm boundaries are marked by wild hedgerows, and there are still bits of woodland left. The Adirondack mountains form the background.

BOTTOM. A clearing in the virgin forest made by a settler in Idaho. The lit-

Indian clearings amounted to as much as 2,000 or 3,000 acres. All his examples are from the eastern third of the country.

The famous mounds of the Mound-Builders are of course well known. Scattered along the river courses nearly throughout the eastern half of the United States, these burial or ceremonial mounds of earth are still conspicuous features of American land. Some are very large, some are shaped to resemble animals, others are small, and many of them have yielded considerable information about these early peoples.

Indians of the Southwest were likewise settled in their habits. They too cultivated fields of corn (Plate 9), tobacco, squash, and beans. Like the Indians of the East, they also dug up the ground with spade-like tools or digging sticks. They had no plows; they did not cultivate a whole area, only the little hills in which the seeds were planted. In addition they grew cotton, and they had irrigation systems which in some places were remarkably extensive. In the valley of the Salt River—a tributary of the Gila—for example, at least 250,000 acres of land seem at one time to have been under irrigation. The ancient canals and ditches, interestingly enough, have been used by moderns.

In the grassland area, the 140,000 Plains Indians lived on the buffalo, and with few exceptions practiced no agriculture whatever. On the other hand they did set fires to stampede buffalo into enclosures, and the effect of these uncontrolled and repeated burnings is believed to have been very great. Thomas Nuttall, famous early botanist, remarked that in places on the prairie the atmosphere was so filled with smoke that an object could be but dimly seen at only 100 yards. Some students claim that the plains vegetation, chewed and trampled by buffalo and periodically burned by the Indians, must have permitted the spread of grass into areas that would otherwise have grown up to trees. In dry

regions where the balance between trees and grass is so nicely adjusted, it is altogether possible that this is true.

In the Far West were to be found the more primitive Indians. Some tribes lived in settled villages, some moved with the seasons, picking berries, digging roots, hunting deer, as they went. The salmon that spawned in the coastal streams from San Francisco north, they speared and trapped at the proper season. From central California south and east, the Indians lived principally on the acorns so bountifully produced by the oaks of that mild region, storing them in great baskets for later use as food. Some of these tribes may have burned the forest as other tribes did, to provide clearings in which game could more easily be seen and hunted. But the total effect of these peoples on the land was by no means as great as that of their kin to the east.

In total, for all their small numbers, the original Indians did quite a bit to alter the face of the land. They burned the vegetation, cleared local, often sizable areas, cultivated the various crops they used, erected great burial mounds, and succeeded in distributing the seeds of many wild plants hither and yon. Some tribes, if not all, moved their villages from place to place, burning, clearing and cultivating at each new location, and leaving old locations to grow up in brush and eventually trees.

Thus it is clear that the great virgin forests had, in fact, been disturbed to some extent, and that they were not wholly continuous. It is also clear that the grassland was affected in many ways by the Indians. And it is certain that the more or less extensive irrigation projects of the southwestern Indians also changed the landscape considerably in one place or another.

Besides the Indians, the land was inhabited by enormous numbers of wild animals. The diaries of early explorers are filled with references to the game birds and mammals that later were hunted down for their meat, their fur, their skins, or just for sport.

Big game was, for obvious reasons, far more abundant then than now. We have no exact measure of the numbers of animals, but some interesting and trustworthy estimates have been made by Ernest Thompson Seton, famed naturalist and writer, in his *Lives of Game Animals*. He believes on good evidence that originally there were as many as 40 million whitetail deer, the same number of antelope, 10 million elk, 60 million buffalo, 2 million wolves, half a million black bears, and some 60 million beaver. These figures apply in part to Canada, and for antelope, to Mexico, but for all that, they are really enormous in view of the fact that present numbers are so small. All the cattle we have in the United States at the present time, for example, would be roughly equivalent to the number of buffalo present in primitive times. Yet there are no truly wild buffalo left in this country today (Plate 2).

Early travelers support Seton's estimates. Townsend's narrative of a journey to the West in 1834 relates:

> Toward evening, on rising a hill, we were suddenly greeted by a sight which seemed to astonish even the oldest among us. The whole plain, as far as the eye could discern, was covered by one enormous mass of buffalo. Our vision, at the very least computation, would certainly extend ten miles, and in the whole of this great space, including about eight miles in width from the bluffs to the river bank, there was apparently no vista in the incalculable multitude.

The buffalo was, of course, the biggest game animal that ever existed in America. Cortez saw the first one ever seen by a European in a zoo maintained in Mexico City by the Aztecs, whom that Spanish gentleman was in process of conquering. And the first Englishman who ever saw the huge animal was Sir Samuel Argoll, later a deputy governor of Virginia. Appropriately enough, he had his first view about where Washington, D.C., is now located. And this indicates something not generally realized, namely, that

although most of the buffalo were found on the prairies and plains, as many as 5 million of the beasts inhabited the eastern woodland areas.

The buffalo trails had a very great deal to do with the history of the United States. The hard roads they trampled into the ground were conspicuous features of the early landscape, and they became eventually convenient ways of travel for men.

'It is very wonderful,' remarks the historian Archer Butler Hulbert, 'that the buffalo's instinct should have found the very best courses across a continent . . . Yet it did, as the tripod of the white man has proved; and until the problem of aerial navigation is solved, human intercourse will move largely on paths first marked by the buffalo.'

It was the buffalo, he goes on to say, that 'found the strategic passage-ways through the mountains . . . and marked out the most practical portage paths between the heads of our rivers—paths that are closely followed today, for instance, by the Pennsylvania and the Baltimore and Ohio railways through the Alleghanies, the Chesapeake and Ohio through the Blue Ridge . . . and the Wabash Railway between the Maumee and Wabash rivers.'

Of the little animals, estimates have been made that stagger the imagination. Seton arrives, for instance, at the astonishing figure of one billion for the numbers of gray squirrels that were present in the great forests. No one has made any computations concerning their numbers at the present time, but gray squirrels no longer teem in the woodlands as they once did. These small animals had and still have much to do with planting the seeds of the forest trees.

Waterfowl lived and bred in America's lakes and watercourses in numbers difficult to conceive today. The best consensus of observers—accurate data lacking—places their numbers at 150 mil-

lion as late as 1900. By 1935 the birds had reached an all-time low of something less than 30 million. How many there may have been originally no one knows. Nor does anyone know how many passenger pigeons there might have been, birds that darkened the sky for hours as their massive flocks flew overhead. Today they are completely gone.

But all the myriads of birds and mammals that swarmed in the vast territory now the United States were part of the wilderness. Beaten back or exterminated by civilization as the forests were cut and the land plowed, these animals are no longer part of the American scene. The big animals are present in goodly numbers in the remaining woodlands; the biggest of them all are preserved in refuges. The great flesh-eaters—wolves, panthers, and the like—are exterminated or driven into the remote reaches of unused country. Some species, taking kindly to farm land, have increased—as have certain quails. Some exist in spite of man, and some exist because of man. But the great populations are gone, along with the primitive forests and grasslands that once supported them.

Many decades ago John James Audubon, great naturalist of the nineteenth century, had this to say about America:

When I think of these times, and call back to my mind the grandeur and beauty of those almost uninhabited shores; when I picture to myself the dense and lofty summits of the forest, that everywhere spread along the hills, and overhung the margins of the stream, unmolested by the axe of the settler; when I know how dearly purchased the safe navigation of that river has been by the blood of many worthy Virginians; when I see that no longer any Aborigines are to be found there, and that the vast herds of elks, deer and buffaloes which once pastured on these hills and in these valleys, making for themselves great roads to the several saltsprings, have ceased to exist; when I reflect that all this grand portion of our Union, instead of being in a state of nature, is now more or less covered with villages, farms, and towns, where the din of

hammers and machinery is constantly heard; that the woods are fast disappearing under the axe by day, and the fire by night; that hundreds of steam-boats are gliding to and fro, over the whole length of the majestic river, forcing commerce to take root and to prosper at every spot; when I see the surplus population of Europe coming to assist in the destruction of the forest, and transplanting civilization into its darkest recesses;—when I remember that these extraordinary changes have all taken place in the short period of twenty years, I pause, wonder, and, although I know all to be fact, can scarcely believe its reality.

Whether these changes are for the better or for the worse, I shall not pretend to say; but in whatever way my conclusions may incline, I feel with regret that there are on record no satisfactory accounts of the state of that portion of the country, from the time when our people first settled in it . . .

## II

# THE LAND NOW

SOME portions of the great wilderness that was America three centuries ago exist yet, but by far the most of it has been replaced by an entirely new pattern of land uses. The story behind this great change is essentially the history of the United States, which, of course, is far too long for this book. Yet a few of the high points are worth scanning in order to understand better the land pattern as we see it now.

To begin with, it took quite a little while for the frontier to get under way. There were a few settlements in the new land about 1600, but even a hundred years later, settlement was still confined to a strip scarcely more than a hundred miles wide along the Atlantic coast from Massachusetts to Virginia. By the time of the American Revolution there were about as many people in the country as there are now in Brooklyn, and the frontier was crossing the Appalachian Mountains with 3,000 miles yet to go.

Once across the eastern mountains, the frontier began gathering speed. It crossed the next thousand miles to the Mississippi River in 50 years, and the last 2,000 miles to the Pacific Ocean in another fifty. In the meantime enormous areas of new land were being added to the original thirteen States. Thomas Jefferson negotiated the purchase of Louisiana from Napoleon to get the important port of New Orleans, but the whole Great Plains were included in the deal. Spain sold us Florida after much dispute and not a little fighting. The Republic of Texas entered the Union after trying for eight years to be admitted. The Pacific Northwest,

once called the Oregon Territory, came to us after considerable negotiation with England; and after a war with Mexico, we obtained the Southwest, including California. In 1853, in order to straighten out our national boundary, we bought a strip of land along the southern edge of Arizona and New Mexico—and the continental territory of the United States was completed. At about the same time the frontier reached the Pacific Coast.

Early in the history of the United States, Congress had the problem on its hands of getting enough revenue to pay national expenses, and undertook to solve it by selling the public lands to all comers. Our country had plenty of land, if not much else; and it was apparently limitless in extent. Counting land given to the nation by seven of the original thirteen States, and all the new land acquired, the United States eventually had one billion three hundred million acres of land that cost about four and a quarter cents an acre. New States were given generous grants to be used for support of schools, reclamation, and various internal improvements. Liberal quantities—unnecessarily liberal in some cases—were given outright to railroad companies to encourage railroad building. Land companies bought large slices for a song. Soldiers were granted land as a reward for service. And people by the millions took up nearly a quarter of a billion acres of land under various homestead and other laws.

Handling such a vast amount of land and disposing of it properly was a complex, gigantic task. As might be expected, the laws and policies governing the job were changed many times, and fraud and politics played their parts. Eventually the nation began to awaken to the fact that it might be wise to withdraw certain kinds of lands from the general bulk of public lands and to reserve them for the nation as a whole, instead of turning them over to private owners. This movement began about 60 years ago and has resulted in taking out lands for Indian reservations, reclamation

projects, National Parks and Monuments, National Forests, National Wildlife Refuges, and lesser amounts for the Army, Navy, Post Office, and other branches of the government.

By 1934, after all the grants, sales, gifts, and reservations had been subtracted, about 180 million acres of public domain were left. This land, in the West, was made up, according to a Senate report, of remnants left after careful culling by many agencies. The residue consisted of the least desirable portions of the original acreage, and included the 'poorest 10 per cent of the land west of the Mississippi River.' By now the major portion of the tag end has become public grazing lands under the administration of the Grazing Service, so that not much more than 50 million acres are left. It seems reasonable to believe that this bit will be put under some sort of management, and when it is, America will be completely taken up.

## Settlement

As the frontier made its great sweep across the continent, it affected the land relatively little. In its wake, however, the land was being filled in by settlers who were toiling at the task of clearing land for farming (Plate 4). For the most part, the settlers paid little attention to the claims or rights of the Indians. They were bent on getting the land to producing crops in order that they might live.

The great forests were cut and burned. Timber of immense value was destroyed wholesale to make way as quickly as possible for the new order. One Englishman, traveling the new turnpike in Pennsylvania, remarked that 'many thousands of trees that were cut for making the turnpike, lay rotting by the sides of it—this day only, we passed some thousand loads of lumber thus decaying. I believe I have seen more timber in this wasting state than all the growing timber I ever saw in my life in England.' On thousands

of pieces of land the trees were girdled, the brush grubbed out, and corn planted among the skeletons of the dead trees. Later, as the need for immediate food grew less acute, the trees were felled, dragged into piles, and burned after they had dried. When one thinks of the magnificent cherry, walnut, oak, and other fine wood that went up in smoke, the retrospect is appalling. Altogether, the forests on about 150 million acres of American land were destroyed by fires set by the settlers to get rid of the trees.

The prairies were plowed, and a tough job of plowing it was. The heavy, thick sod formed by the lush native grasses was not turned over easily. The richer the land, the heavier the sod, and the more horses or oxen it took to pull the crude plows. But little by little the land filled in, and as it did the pattern changed (Plate 4).

Swamps and morasses, last of the land to be cleared, were drained to provide more space for crops. Ditches, big and little, were dug to carry off the standing water, and today in the lowlands of the country you can see immense tracts covered with a criss-cross of drainage ditches without which the soil would become wet and sour. Some of the drainage enterprises were unwise, and the land has since been flooded, perhaps to provide refuges for waterfowl. In dry and arid country the reverse of this process went on. Water was carefully hoarded and preserved in reservoirs. Dams, big and little, were built to back up streams. And through a network of irrigation ditches, the precious water was flooded on the land to make the desert 'blossom as the rose.'

The land was rich, and it produced lavishly at first. As the available plant foods were used up, people moved on to new land. No very great attention was paid to keeping land in good condition. The same crop was planted year after year till the land ran out, as it will always do under such treatment. Land was 'tobaccoed' to worthlessness, 'cottoned' to death. Erosion was not under-

stood except by a few, and every rain carried its load of soil away, down the plow furrows into the creeks and rivers, which turned from sparkling clearness to muddy, yellow brown. But then, nobody needed to worry because there was always more land.

Before the frontier had passed the Mississippi—in fact, well before Pennsylvania was settled—the Philadelphia Society for Promoting Agriculture was offering prizes for methods that would restore worn-out land. 'For the best method,' the Society announced, 'within the power of common farmers, of recovering old gullied fields to a hearty state . . . as will again render them fit for tillage; or, *where the gullies are so deep and numerous as to render such recovery impracticable*, by planting trees, or otherwise . . . a gold medal; and for the next best—a silver medal.' The italics are the present author's. One gathers from the statement that even at that early date, at least some lands had been ruined so completely that they were unfit for ordinary farming.

It has been said that the methods used by early settlers to develop land were essentially destructive, and so they were. Everything in the way of occupying land was destroyed—Indians, wildlife, timber, prairie grass, and all. Yet, from a practical standpoint, the wilderness and its denizens had to go, and however much we may regret the waste and destruction accompanying the process, the conquest and development of America was an accomplishment of which Americans are justly proud.

## American Land and Its Uses

The United States now includes within its boundaries a little more than 3 million square miles, and, except for Russia and Brazil, this makes it the biggest country in the world. Most of its enormous area is used for agriculture, which is the reason why America from the roadside seems to be principally in farm or ranch land. There is, incidentally, a great deal of agricultural land that

is never cultivated—such as the great area of western range used for grazing livestock—so that there is a difference between farmland and land used for agriculture in the broad sense. That is why you may often see one figure for land in farms (55 per cent of the country), and another for all agricultural land (85 per cent).

Almost three quarters of the United States belongs to private owners; that is, 73 per cent of American land is private land. The other quarter is owned by the federal, state, county, or city governments; that is, 27 per cent is public land. If you will add these two statements together, you will find that *all* the land in the country belongs to somebody or other, or to a government agency. This is important to realize, and often difficult for the city-dweller to grasp. The point is that land—with or without a fence around it, whether there is a house in sight or not, and whether it has a sign on it or not—is all owned.

The pattern of ownership is often amazingly varied. Land in many of the western States, for example, may be a patchwork of pieces owned by any one of a number of government agencies, by private individuals, by schools, by railroads, and by various other groups. If each piece is colored to correspond to the various owners, the map looks like a very fine piece of mosaic. Very little western land is fenced; hence it is a pretty difficult matter to decide whose land you may be on when you stop along the road. People rent their lands to each other, the various government agencies rent their lands for various uses, and one public agency may lease its land to another public agency, which in turn rents the land to a private individual. Westerners know all about this confusing business, but Easterners seldom understand that the western lands stretching away to the horizon may (and usually do) belong to hundreds of owners who have a fairly good idea where their boundary lines are.

While we are discussing western lands, it is worth noting that

there are a number of States in which more land belongs to the Federal Government than to private owners. About 70 per cent of Idaho is public land, for example, and 76 per cent of Arizona, and 80 per cent of Nevada. Even 44 per cent of California is owned by public agencies. There is much more private land per State in the East, where public land is consistently less than 40 per cent, and in most States, much less.

The following table will give you a rough idea of major uses of land in the United States:

| | |
|---|---|
| TOTAL LAND AREA | 1,903 million acres |
| Farms | 1,054 million acres |
| Private timber land | 216 million acres |
| National Forests | 155 million acres |
| Public grazing land | 142 million acres |
| Indian land | 55 million acres |
| State Wildlife Refuges | 50 million acres |
| Highways and roads | 20 million acres |
| National Park areas | 17 million acres |
| National Wildlife Refuges | 10 million acres |
| Cities and towns | 10 million acres |
| State forests | 11 million acres |
| State parks | 4 million acres |
| Railroad rights-of-way | 4 million acres |

The observant reader will note immediately that the different lands listed in the table do not add up to the total. There are a number of reasons for this. One is that no person or agency has ever yet compiled a complete and accurate set of figures; hence collecting such figures is difficult. Another is that the table repeats itself somewhat, since some land in refuges is also in parks or forests, and vice versa. A third is that some lands are left out, such as tidal land, post-office sites, army land, resettlement projects, and many other minor and miscellaneous items. The figures are correct

to the nearest million, however, and for general purposes give a fair picture of the distribution of land in this country.

The figures in the table show clearly what a large slice of American land is in farms. The lion's share is privately owned, but even so, 21 million acres are owned by government agencies. On the other hand, as we will see later, much public land—as in National Forests, for example—is used for grazing and hence is as agricultural as neighboring private lands also used for the same purpose. We could go on to examine all the different kinds of land in farms, but instead of doing it here, we can note them in passing, in later chapters.

The story we are about to tell of American land and the way it is used has about it some points that have escaped many historians. The development of America has not been altogether the simple business of transplanting European culture to a new land and making it flourish. There are too many things basically different in America for that. The fact is that ways of life are shaped in good part by the kinds of places in which men live. The story of America is actually one of growth away from Europe, toward a way of life fitted to a new environment, and because this is so, eventually the European settlers of America changed quite as much as they changed the landscape. And ever since, although there are still to be found many traces of European culture in America, Americans have steadily moved away, just as the frontier did, from the influence of Europe toward a life that is as truly American as the land itself.

## III

# GRAINS ON THE LAND

So many thousands of years have gone by since mankind first began to cultivate grain, that the origin of its use has long since been forgotten. Yet, all the great civilizations of the world have depended on wheat, or rice, or corn, as their most important source of plant food. Our own depends primarily on corn, but importantly also on wheat. The peoples of China, Malaysia, and India rely on rice. The empire of the Incas in South America depended on corn. The ancient civilizations of Babylon, Persia, Egypt, and Greece used wheat as well as barley and lesser grains. It is, in fact, generally agreed that without the basic foodstuff supplied by the cereals, really great civilizations could not exist.

There are only six true cereals—wheat, corn, rice, barley, oats, and rye—and they are all grasses. All of them but corn come from the Old World and are called cereals from Ceres, the goddess who, according to the Romans, gave grain to the world. There are some others that are not true cereals but are sometimes referred to as if they were. Millet, for instance, and sorghum and buckwheat are in this class; they are often called pseudo-cereals.

The six true cereals ordinarily occupy more land in this country than all the rest of the crops we grow put together. It would be an unusual trip into the countryside that did not discover a field of one of these six grains. Using long-time average figures, the big six are grown on about 60 per cent of the land used for all of our crops, including hay. This is a lot of land—more than 200 million acres of it.

Cereals are easier to grow than many other crops, and for the amount of land they occupy and the small amount of labor needed to cultivate them, they yield a large amount of food. Their food value is high, and the grains are easy to store and handle because they are dry. They contain a very high percentage of carbohydrates as well as goodly amounts of proteins, some fat, and, yes, even vitamins.

For a beginning let us have a look at the Old World cereals, reserving a special chapter for the American protégé, corn. Certainly we should start with wheat since it occupies more land in the world than any other crop.

## Wheat

A long time ago, perhaps as much as 6,000 years before our time, primitive people in certain parts of Europe were growing some of the simpler types of wheat. By now wheat is grown all over the world except in the hot lowlands of the tropics. It is being harvested in Australia and Argentina in January, and in India in April or December. In fact, in one country or another, wheat is being harvested the year round. In the United States we grow on the order of 750 million bushels of it and set aside about 56 million acres of land to do the job.

All this implies that wheat must have had a most remarkable history to have become so important and to have accompanied mankind for so long. But unfortunately, although many distinguished scientists have worked at the problem, even the birthplace of wheat is still in dispute. Recent studies by the Russian scientist Vavilov, for example, seem to show that the soft wheats came from northwest India and Afghanistan, the hard, durum wheats from the Near East, and other types from the Mediterranean region and from Ethiopia. But other workers claim wheat came only from the Tigris-Euphrates Valley or from any one of

PLATE 5 A great field of bearded wheat in Texas. Planted the year before this picture was taken, it yielded 40 bushels of grain for each acre planted.

BOTTOM. Harvesting wheat in Nebraska. The machine is a reaper with a binder attached that throws off the bundles on the side.

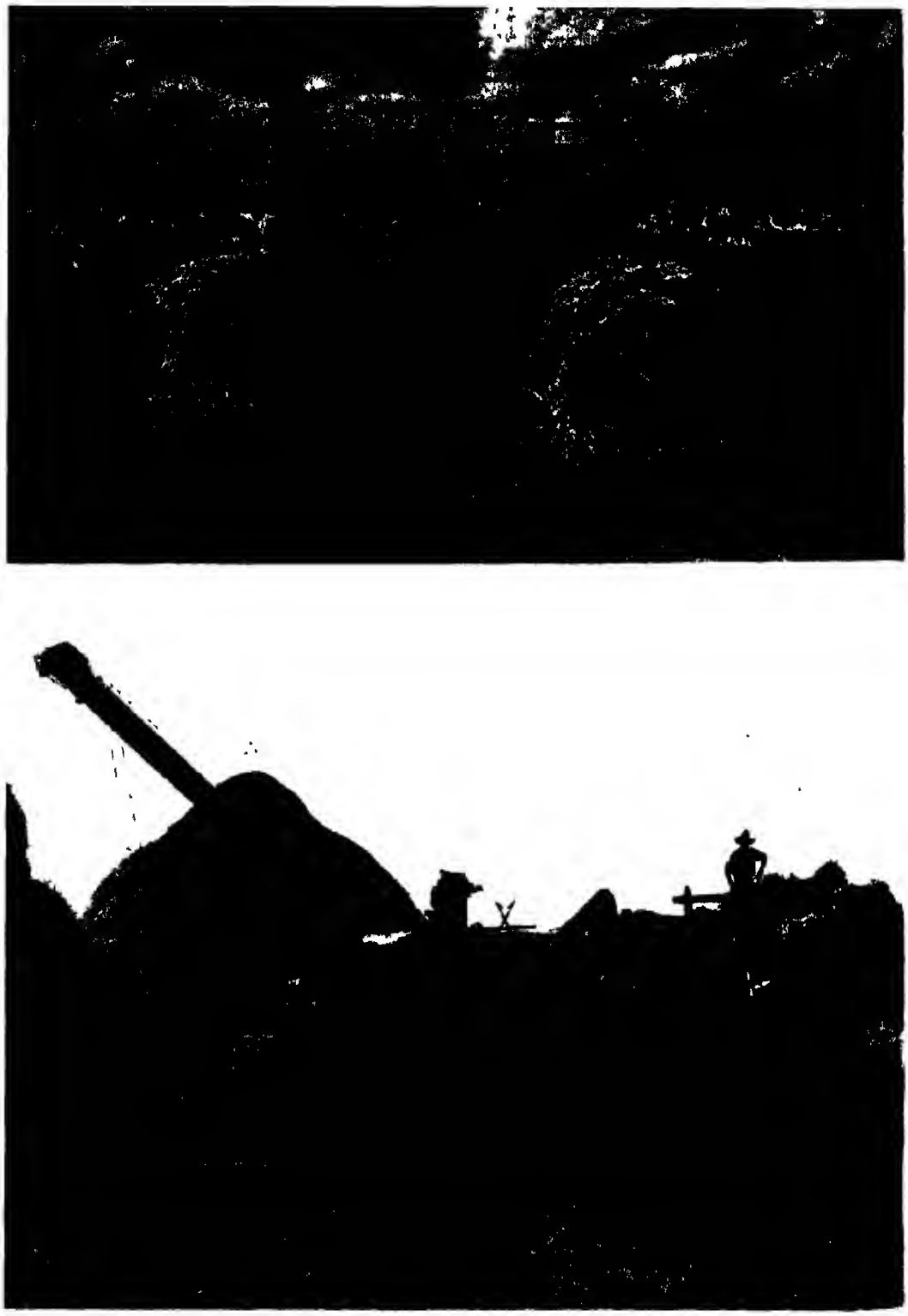

PLATE 6. Wheat bundles piled in shocks to ripen are being taken to the barn for threshing. Other grains may be handled in the same way.

BOTTOM. The wheat bundles are thrown into the threshing machine. Under the long arm that spews out the chaff, men are filling the sacks with threshed grain.

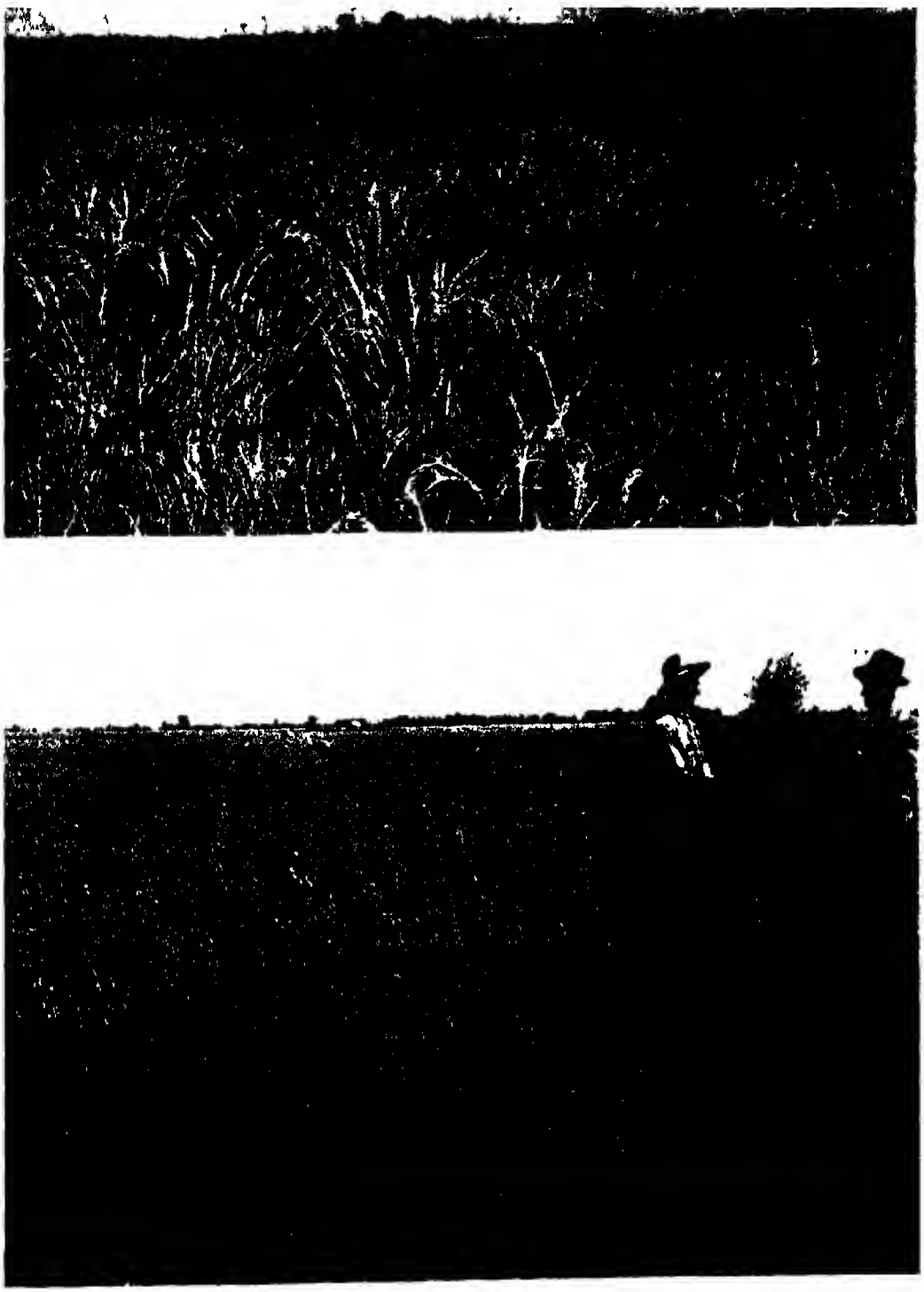

PLATE 7. A field of rice just about ready to harvest. Water that formerly flooded the field has been drawn off. The grain will be harvested like the wheat in Plate 5.

BOTTOM. A field of oats in South Carolina. This grain is usually easy to distinguish since the heads are loose and open.

PLATE 8. A field of rye in South Carolina. Rye, wheat, and barley are often difficult to distinguish unless the heads are examined closely.

BOTTOM. The heavy headed, corn-leaved sorghums are not difficult to identify in fruit. Young plants may resemble corn.

several other areas. There is disagreement, in other words, whether wheat originated in one place or several. For the present, therefore, it seems safest to say that wheat may have originated in several places somewhere in southwestern Asia.

Wheat reached the New World in 1529, when the Spaniards shipped some of it to Mexico. In view of the importance of corn among the Aztecs, this introduction had all the appearance of carrying coals to Newcastle. However, as the Europeans continued to arrive in the Americas, they brought seeds of their crop plants along with them, and wheat came with the rest. It was grown in New England in 1602. The famed Jamestown Colony sowed it in 1611. It was carried westward in the United States by the pioneers who were settling this country, and by 1845 it had reached Minnesota.

In the West, wheat was brought in from Mexico and the West Indies. California had wheat by 1769, and it reached Oregon a little less than a hundred years later. Some of the older varieties brought in first are still planted. The Pima and Yuma Indians of Arizona, for instance, still plant the variety known as Sonora wheat, which they first began growing in 1825. Over the country as a whole we now grow several hundred varieties, many of which have been developed in this country by our plant breeders since colonial days.

During the Revolutionary War, the Bread Basket of America was not in the wheat belt we have now. Instead it was located in Vermont. Later on, when the West opened up and people began to leave New England, the wheat fields of Vermont became sheep pastures and eventually dairy land. A number of other crops have shifted in this same manner.

The most primitive of the wheats are the ones known as einkorn, emmer, and spelt. In these types the grains are enclosed in chaffy envelopes, and getting them out—thrashing—is not an easy

job. Einkorn you may never see in this country unless you visit an agricultural experiment station. The red-seeded emmer and spelt we grow somewhat for livestock or possibly breakfast foods. All three of these wheats are very ancient; the Babylonians grew emmer and so did the ancient Lake Dwellers of Europe. Polish wheat (sometimes known as giant rye) and Poulard wheat are two other kinds rarely to be seen in the United States, although they are grown in Europe or western Asia.

The wheats we grow in this country are classed as club wheat, durum wheat, and common wheat by botanists. All of them are relatively easy to thrash, and they are of very great importance to us as food. Club wheats, of which we grow the least, are soft and are used for pastry-making; durum wheats are hard and make the best macaroni; the common wheats, of which we grow the most, are more or less in-between and are the ones we use for bread-making.

We could go on, listing grades, varieties, and strains, but if we did, this book would grow very much larger. The whole list would include 5 standard grades with about 200 commercial varieties selling under nearly 700 names—in the United States, that is. For the rest of the world there would be many hundreds of strains more. For our purposes we may note that there are two kinds easy to recognize from the roadside. One is winter wheat, sown in the fall and harvested in early summer. The other is spring wheat, planted in the spring and harvested in late summer.

We should note in passing that a tremendous amount of work has been done with wheat by plant breeders. The number of agricultural experiment stations, private individuals, and agencies that have labored at making wheat a more useful plant is very large. The whole story is set forth in the 1936 *Yearbook of Agriculture*, and very good reading it is. One paragraph is worth quoting:

More striking than the growth of an oak from an acorn is the fact that the vast hard red spring wheat industry in the United States, with all the milling, baking, transportation, and trading dependent on it, developed from a few seeds saved from a single wheat plant. The origin of this plant shows how plant breeding cuts across and disregards national boundaries, to develop products useful to all men and all nations. The variety that founded the hard spring wheat industry came originally from Galicia, in Poland. From Galicia it went to Germany. From Germany it went to Scotland. From Scotland it went to Canada. From Canada it came to the United States. It was David Fife of Otonabee, Ontario, who saved a single plant of spring wheat out of a lot of winter wheat obtained from a friend in Glasgow. From this single plant came the variety known as 'Red Fife,' which in turn was a parent of the world famous Marquis developed by C. E. Saunders. The development of Marquis has stood out for years as the greatest achievement in wheat-breeding history.

*Growing Wheat.* A good part of the wheat grown in the United States comes from the northern Plains, the central-southern Plains, or the Pacific Northwest (see map, p. 53). We grow wheat, of course, in every State in the Union, but these three areas are looked to as the most important producing centers. In the northern Plains the wheats are spring wheats; the climate is far too severe for young wheat seedlings to get through the winter alive. In the southern Great Plains, however, the wheat grown is winter wheat (Plate 5). It is sown in the fall, gets a good start before frost, then in the spring picks up where it left off, and ripens ahead of spring-sown wheat by several months. In the great wheat-growing areas of the Northwest, including the famous Palouse region, we grow both spring and winter wheat. And besides these places, we grow many millions of acres of wheat in dozens of other States.

The wheat we grow generally produces about 14 or 15 bushels

of grain per acre. In the fourteenth century wheat produced about 8 bushels per acre. In 1895 on land in Island County, Washington, a field of 18 acres produced 117.2 bushels per acre—a world record. The winter wheats yield more bushels per acre than do the spring wheats. And ordinarily, where corn does well, wheat is not grown, because it is not as productive per plant and acre as corn is. Hence, the Corn Belt does not raise much wheat, and the wheat belts do not raise large amounts of corn.

Wherever wheat is grown, the land has to be very clean, for weeds choke out wheat plants very easily. The wheat seed is carefully cleaned, treated with chemicals to destroy any fungus, and scattered by hand or sown by machines on the cleared land. Machines that plant wheat in rows are known as drills, and drilled wheat yields more than broadcast wheat.

When the young plants appear they look like so many grass plants—which is exactly what they are. Most commonly they are in parallel rows rather closely set together, because most wheat is planted by drills. If the wheat was sown in the fall, it looks like nothing more than young grass all through the winter. If it was sown in the spring, it keeps on growing until eventually the spikes of wheat begin to appear. Gradually, as the grains store food, the spikes turn lighter green, then become tinged with yellow. Finally spikes, plant and all turn golden brown, and wheat harvest time has come.

There are all kinds of ways to harvest wheat. It can be done with a scythe or a simple reaping hook, or a cradle, which is a scythe with wooden fingers to catch the grain. Or, where the acreage is large, a reaping machine can be used that will cut the wheat, followed by a binding machine that ties the long stems into bundles (Plate 5). Or, if the acreage is very large, a portable factory known as a combine can be used. This cuts the wheat, cleans it, sorts the grain into grades, bags it, ties up the straw, and throws

bags and bundles off behind. Combines are used principally in the wheat centers we discussed above; they may require up to 40 horses or a very high-power tractor to pull them.

Various kinds of reapers, binders, or combines can be seen in operation when wheat or other grains are ripening. In most parts of the country, where combines cannot be used because wheat farming is not done on a big scale, there is another machine that enters the picture. After the wheat is bound into bundles it is stacked in the fields to wait until it cures (Plate 6). The bundles are then hauled into the barnyard and fed into a thrashing machine. This spews out the wheat straw into a great pile on one side and pours out the golden grain into bags on the other (Plate 6).

Wheat has to be stored in well-ventilated bins that are firmly built to keep out rats and insects. The round, corrugated iron bins of the Ever Normal Granary are often seen from the roadside. So are the great grain elevators along railroad tracks, where wheat and other cereals are stored waiting shipment.

*What We Get from Wheat.* About a fifth of what we eat in this country comes from wheat. Bread, of course, is the staff of life and is possibly most familiar of all wheat products. It is made from hard wheat. Cakes, pies, pastry, crackers, biscuits, rolls, and the like are made from soft wheats. Then there is the great array of breakfast foods—shredded wheat, puffed wheat, bran, wheat mush—and macaroni, spaghetti and noodles. All of these come from wheat.

Wheat is used to make beer as well as other beverages, and industrial alcohol. Starch from certain varieties is used for textile sizing. Wheat straw goes into mattresses, straw carpets, string, beehives, baskets, and hats. And besides all these uses, wheat reaches us in the form of meat from animals—such as chickens, pigs, and beef cattle—that are fed on it.

## Rice

At Charlestown, South Carolina, in the year 1685, the first rice in America was planted in the governor's garden as an experiment to learn what this remarkable cereal would do in the British colonies. By 1839—as late as a hundred years ago—most of the rice in this country was grown in the Carolinas and Georgia—a state of affairs that lasted until the Civil War. But by the turn of the century, rice production had moved west and south so that now the commercial crop comes from Louisiana, Texas, Arkansas, and California (Plate 7). A strange story this—200 years of production in the South Atlantic States, then a major shift to new fields, until today the Carolinas and Georgia produce very small amounts.

We grow a little more than 50 million bushels now, each year, on about a million acres of land. In comparison with other parts of the world, however, this is a pretty small business, since the whole world grows about 7 billion bushels on nearly 200 million acres. We could grow a lot more than we do if each person in the United States would eat more rice, say the experts, but it costs us more to produce than it does to import the cheaper Asiatic rice.

The fact is that rice is pre-eminently a cereal of the hot tropical countries, and as such it does not figure largely in grain production in the United States. There is a dispute over the place it originated, some scientists claiming India, others China, and conservatives southern India and Cochin China. At any rate, it is in the warm parts of southeastern Asia that rice is so important. There also, the laborious methods of growing rice, involving the transplanting of young seedlings by hand to the field rows, are practiced.

In the United States rice is grown much as wheat or oats, except that the crop is irrigated. The seed is sown in April and May either by drills, broadcasting machines, or airplanes. Sometimes the rice

is planted in the water—as in California—and sometimes it is planted on moist soil later to be submerged under 4 to 8 inches of water. When harvest time comes, the water is drawn off and the rice is harvested about the same as wheat except that special kinds of reapers and binders may be used. Rice is also harvested by combines in California.

Rice is the principal food of about half the people in the world, and enough of it is produced each year to supply a little over a hundred pounds for every man, woman, and child on earth. It has been in cultivation for some 5,000 years, and a great many thousand varieties of it are known. The yields per acre are much higher in other countries than in the United States, although some very excellent breeding work is bringing our figures higher and higher all the time. If we needed more rice we could use up to 10 million acres along the Gulf of Mexico to grow it. As the situation stands, however, it is a minor crop in America.

## Oats

Sowing wild oats may be frowned on, but a long time ago the sowing of wild oats resulted in the beginning of a very important cereal crop. There is uncertainty about the time and place, because oats originated so very long ago. Some scientists believe oats came first from western Europe, others believe the grain came from China, while recent studies point to the Near East. Still other scientists have suggested that oats, and perhaps barley and rye, were weeds that usually came up along with wheat, and that during the course of time these weeds came to be cultivated also. The true ancestor or ancestors of our present-day cultivated oats are not certainly known, but apparently several species of wild oats are involved, and apparently also oats have been cultivated for several thousand years.

Oats for human food are far more important in other countries

—Scotland for instance—than in the United States. Less than 4 per cent of our oat crop is made into rolled oats or oatmeal. We use the rest principally for livestock feed. Nevertheless, we usually grow a little over a billion bushels each year on about 37 million acres of land, and ordinarily we lead the world in oat production (Plate 7). The Corn Belt is the most important oats-growing region, but better oats are grown farther north. In Scotland about a third of the land is devoted to oats, and half of Ireland is sown to it. Perhaps there the people realize, as we do not seem to here, that oats are the most nutritious of all cereals for human use.

Horses are especially fond of oats. One agriculturist has pointed out that oats are to horses what gasoline is to the automobile—a high-energy fuel. But oats are also very useful in crop rotations, as we shall see in the last chapter. In many ways the use of oats reminds one of the use of corn; most of both grains are fed to livestock, but both are of great importance in producing food.

### Barley

Out of Ethiopia, and so ancient that no one knows how long mankind has used it, barley was cultivated by the oldest European civilizations of which we have any record. Grown in the United States in much the same areas as wheat, it now occupies about 14 million acres of land and produces upwards of 300 million bushels of grain each year.

Barley is best known because it is the chief source of the malt used for making beer, ale, porter, and stout. Malt is made by sprouting the barley seeds, drying them just after the shoots have started, and grinding them to make the finished product. Malt can be made from rye or corn or rice also, but most of it comes from barley.

In the field, barley looks very much like wheat or rye, and it is drilled and harvested in the same way as these other grains. Be-

cause it grows rapidly and produces seed in a relatively short time, it can be grown high in the mountains, where the growing season is brief. In the Rockies we grow it at altitudes of as much as 7,500 feet above the sea. In the Andes it is grown at 11,000 feet, and in Russia it has reached the shores of the northern Arctic Ocean. On the famed Mount Everest there is a type of barley that protects itself from the wind by curving its stalks so that the heads are almost on the ground.

During prohibition days, when the demand for malt to make beer almost vanished, farmers turned to using barley for livestock feed. In the South, winter barley is used as winter pasture. Beside these uses the grain is made into barley 'pearls'—which is the way it comes in barley soup—breakfast foods, and barley flour.

Altogether we grow about five dozen varieties of barley, of which the types that make the best malt bring the highest price. Sometimes, where winter wheat is frozen in a hard year, barley is planted in the spring as a substitute—a 'catch crop' farmers call it. In the meantime a collection of more than 3,000 kinds of barley is maintained by the Department of Agriculture against the time when breeding work may be needed to meet new problems that may arise with respect to this grain.

## Rye

Toughest and hardiest of all true cereals is rye, the grain that can grow on poorer soil, in drier country, and survive colder winters than any of the others. A native of the Near East, this grain was unknown to the earliest civilizations, appearing first among the Romans not much more than 2,000 years ago. For all its late start, however, rye provided the most important food of a third of the people in Europe until a hundred years ago. Rye it was that made the bitter, dark, and soggy 'black bread' of which the history books have much to say.

Rye is still a crop of lesser importance in the United States, although many agricultural experts believe it should and will be grown a great deal more. We grow nearly 40 million bushels of it each year, on about three and a quarter million acres. About two-thirds of our crop we feed to livestock; the rest we use for rye bread, or to make whiskey and alcohol.

In the field, rye looks pretty much like wheat or barley, although the bluish cast of its leaves may sometimes give it away (Plate 8). Certainly the heads of grain look like those of many types of wheat. Generally speaking it is likely to be taller than its cousins, wheat or barley, but this character is a poor guide if the plants are growing on poor thin soils. It is sown and harvested for grain about the same as wheat is, with about 99 per cent sown in the fall.

Two by-products of rye are of considerable interest. The first is its straw, which is very tough and better than that of the other cereals; it is used for stuffing in bedding, horse-collars, for paper-making, and for packing. The second by-product is ergotine, of so much value in medicine. The fruiting heads of rye are attacked by a destructive fungus disease known as ergot. The fungus replaces the seeds by a horny black mass, several times larger than the seed. From this misfortune of the rye plant there is prepared a boon to mankind.

Rye has other important and growing uses. If it is plowed under while it is still green, it makes a fine fertilizer, or green manure as the farmers call it. And because it stands up so well during winter or in dry seasons, rye makes a fine plant to cover soil and prevent erosion.

## The Small Grains

At the beginning of this chapter we noticed that sorghum, buckwheat, and millet did not belong to the big-six cereal group. In a way this is a quibble because the grain sorghums, for example, pro-

duce as much grain in the United States as rye and rice together. However, these pseudo-cereals are usually spoken of as 'small grains' and as such we may consider them here.

*Sorghum.* Although Benjamin Franklin found a single seed of broomcorn in a broom brought in from Europe and introduced the plant during the eighteenth century, the rest of the sorghums reached the United States within the last hundred years. Only recently naturalized, the sorghums have quickly made themselves at home, especially in the drier parts of the country where corn cannot grow and where the newcomers' ability to withstand drought makes them so valuable.

There are four kinds of sorghum in the United States—grass types like Sudan grass, which is used for hay; sorgos used principally for molasses but also for silage; broomcorns used for brooms; and the grain sorghums raised for grain and livestock feed. Sorghum means molasses to many people, although less than 3 per cent of the sorghum we raise is used to make syrup, and of this we shall hear more in Chapter 6. Sudan grass comes in Chapter 12; here we are interested in the sorghums that produce grain.

Grain sorghums are rather variable plants and their names are pretty well mixed up. Actually, say the experts, there are 42 varieties grown in this country for grain. These include names in familiar use—kafir corn, durra, milo, shallu, kaoliang, feterita, hegari —but all these are grain sorghums. The names are a give-away in one sense; sorghums came to us from Africa (Kafir is an African name) or from India (shallu) or China (kaoliang), although recent studies claim China as the true original home of all of them. These plants are very ancient, and are by some claimed to be among the first plants cultivated by man.

The sorghums that produce grain are grown on about 10 million acres in the United States, and from them we harvest approximately 100 million bushels. Most of the crop is planted in

the hot dry southern Plains and the Southwest. There the great fields of heavy-headed spikes of sorghum are a familiar sight, and one likely to be seen more frequently since the use of sorghum has been spreading lately (Plate 8). While still young, the plants resemble corn a good deal, but there is no mistaking the big club-heads of grain as the seeds ripen.

The grain sorghums are handled much like corn. The seeds are planted in rows three or more feet apart; the young plants are cultivated to destroy weeds, and the mature plants are usually harvested with corn machinery or combines. The heads may be taken off, or the plants may be shocked like corn and left to cure in the field. Sometimes, as with corn, the seeds are sown very thickly in the rows, so that a lush heavy growth of sorghum plants results that may be cut for cattle fodder.

Broomcorn is found in the same general region as the grain sorghums. Instead of the heavy heads, it has a loose, much branched 'broom' with small seeds. The big varieties are used for ordinary brooms, the dwarf for whisk-brooms.

Important plants, the sorghums, and likely to become more so as new varieties are developed by the plant breeders. To take seventh place among American crops in less than a hundred years is quite an achievement.

*Buckwheat.* In this country buckwheat is not a very important crop, although you can see a great many fields of it in the northeastern United States. We grow about 400,000 acres a year, and produce about 6 million bushels of seed. The plant came originally from China, where it still grows wild, and has been cultivated by man for only about a thousand years. Compared with other grains, this is a short period. Europe didn't get the plant until about 1436, and as far as we know, the Greeks and Romans never heard of it. But those who like buckwheat cakes think the Greeks and Romans missed a lot. And those who like the dark, strong-

smelling honey made from buckwheat flowers may think so too.

You can see from the picture that buckwheat is not a grass, as all the other grains are (Plate 9). It is in a separate family of its own and is not related to the other grains. Its brown or black seed is three-cornered, and looks for all the world like a tiny beechnut. We use the grain for feeding to cattle or poultry, as well as for griddle cakes, and we rely on the bees to make honey out of the flower nectar.

*Millets.* While we grow upwards of a million acres of millet, principally in the Great Plains, we use very little of the crop for grain. These small-seeded grasses—for there are many different species—make excellent hay, and if wheat or some other important cereal fails, millet is often sown as a 'catch crop.'

We use millet seed for feeding to canary birds and as a forage grain for livestock. Millets are ancient plants that have been cultivated for nearly 5,000 years. With us, some are barnyard weeds, some are used for game feeding on estates or refuges, and foxtail or proso millet are used for hay.

## IV

# THE MYSTERY AND THE MASTERY OF CORN

WHEN you hear an Englishman talking about an ear of corn, you may rely upon it that he means a head of wheat. And when a Dutchman asks about Turkish wheat, he wants to know about corn. The Egyptians call corn Syrian durra, the Turks call it Egyptian corn, the French call it Spanish corn. In Africa if you want corn you ask for mealies. In other countries corn may mean any kind of a cereal at all, but in this country, when we say corn, we mean corn.

The fact is that although maize is really the proper name for the great grass, there are many reasons why Americans should call it what they like. Corn came originally from the western hemisphere, and America produces more of it than any other country in the world; in fact, we usually harvest slightly more than all the rest of the countries put together. Once—in 1920—the United States produced over 3 billion bushels, although the usual harvest amounts to about 2½ billion. And once—in 1917—we used 110 million acres for corn, although we usually devote about 85 to 95 million acres to the annual crop. What it all adds up to is that corn occupies more land in the United States—and is more valuable—than any other crop we grow.

In view of all this corn and corn land, it is not surprising to find that you nearly always see some corn during a day's journey in any direction from any place. There are many roads in the United States on which it is almost impossible to get out of sight of a cornfield. This remarkable cereal is the only crop plant known that

can be grown from Canada to the southern end of South America, and from sea level to 12,000 feet in the mountains, over such an astonishing range of soils and climates. But we need not be too complacent about our accomplishments with this grain. American aborigines were growing corn over a similar range, from Canada to southern Chile, when European explorers 'discovered' it, and the corn they had was not primitive. The record unearthed by scientists shows conclusively that all the principal kinds of corn known today were known to the aborigines long before we ever came here.

The Indians of the Americas had popcorn, flint corn, dent, flour, and sweet corn. The corn they grew had red seeds, black seeds, blue, pink, or brown, spotted, banded, or striped seeds, and the white or yellow seeds with which we are most familiar. Some of the seeds were smaller than a kernel of wheat; others were as large as a quarter and, after boiling, were eaten like grapes. Some of the plants were small and produced tiny ears smaller than any grown in this country. Others were gigantic, reaching 18 feet in height and producing ears 3 feet long with the shucks attached. There were varieties taking two or three months to mature, and varieties that took ten or eleven months. All, or nearly all, the great variety of strains of corn are still grown by the Indians of the Southwest, of Mexico, Central America, and South America (Plate 9). And, according to students of the subject, the Indians still hold most of the records for production.

## The Mystery of Corn's Origin

On the shores of the Atlantic a great many of the earliest colonies would certainly have perished had it not been for Indian corn. The savages supplied the pioneers with seed, and showed them how to grow it in hills, using fish for fertilizer. But, although these Indians knew how to make corn grow, and although it was a staple

food for many tribes, they did not know where the plant came from. There were many tribal legends and ceremonies clustered about the plant, but no one of these offers the slightest clue to the origin of the grain.

When Cortez drove forward with his band of adventurers into the mighty Aztec empire of Mexico, he found the landscape literally checkered with cornfields. He found them from the valleys and lowlands to the high levels of the Mexican tableland wherever the Aztecs had settled. Corn was the most important crop of these remarkably civilized people. They knew all about preparing it for the table, and even extracted a sugar from the cornstalks, which are larger there than northward. But the Aztecs did not know where corn came from or, if they did, the story has not survived.

Scarcely more than a dozen years after Cortez, and led on by the same greedy desire for gold, Pizarro invaded the land of the Incas on the western shore of South America. As he and his men proceeded with the destruction of a civilization in many respects more advanced than any European one of that time, they found that the Incas were as dependent on corn as were the Aztecs. We do not know as much about the Incan civilization as we should like, but we do know that they had a highly developed agriculture. They knew how to use fertilizer and were utilizing the guano formed by colonies of sea birds, just as we do today. They had extensive irrigation systems and an elaborate system of aqueducts to supply them with water. They used terracing on hilly land, and they stored corn in great granaries to carry over years of crop failure —just as we do in our Ever Normal Granary. Generally speaking they were practicing soil conservation methods that we have started to use only within the past decade.

Of the five or six dozen kinds of plants that the Incas are believed to have cultivated, corn was by far the most important. It supplied the major portion of their food and was used to make

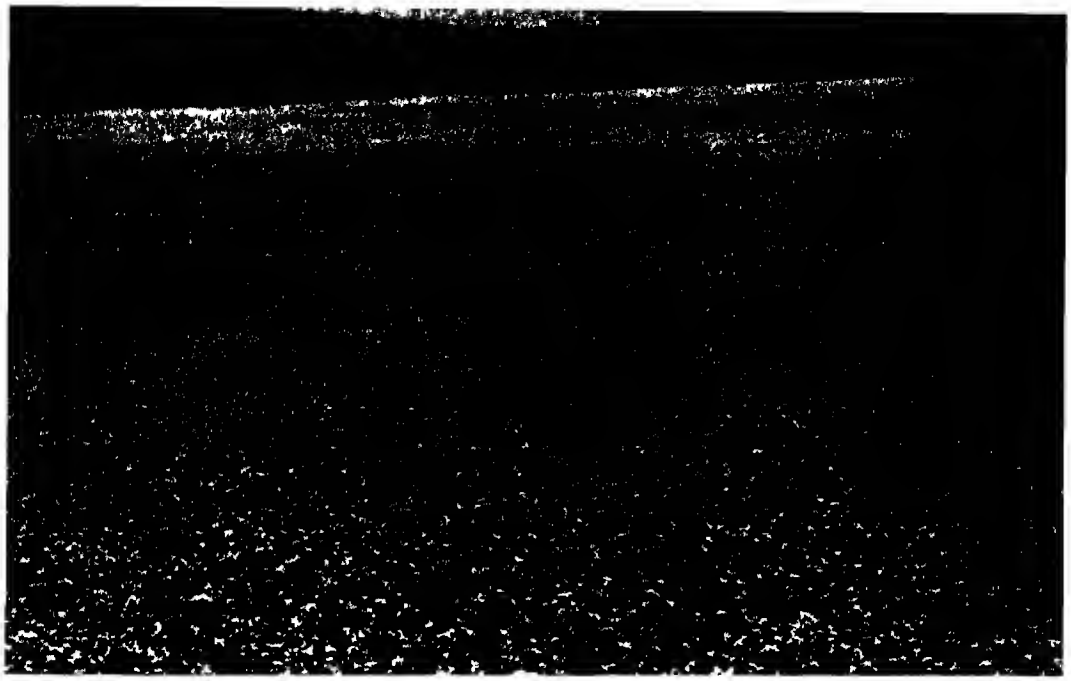

PLATE 9. A field of buckwheat in full bloom in New York State. Good pasture for bees, and a source of buckwheat cakes.

BOTTOM. A field of corn grown by Indians in the Southwest, much as it was done centuries before the arrival of the white man.

PLATE 10. A plant breeder working on hybrid corn. An ear with its silk is on the left; the corn tassels are on the top of the plants on the right.

BOTTOM. A great field of corn in Corn Belt country. The hill on the left shows a thin patch where fertile top soil has been lost through erosion.

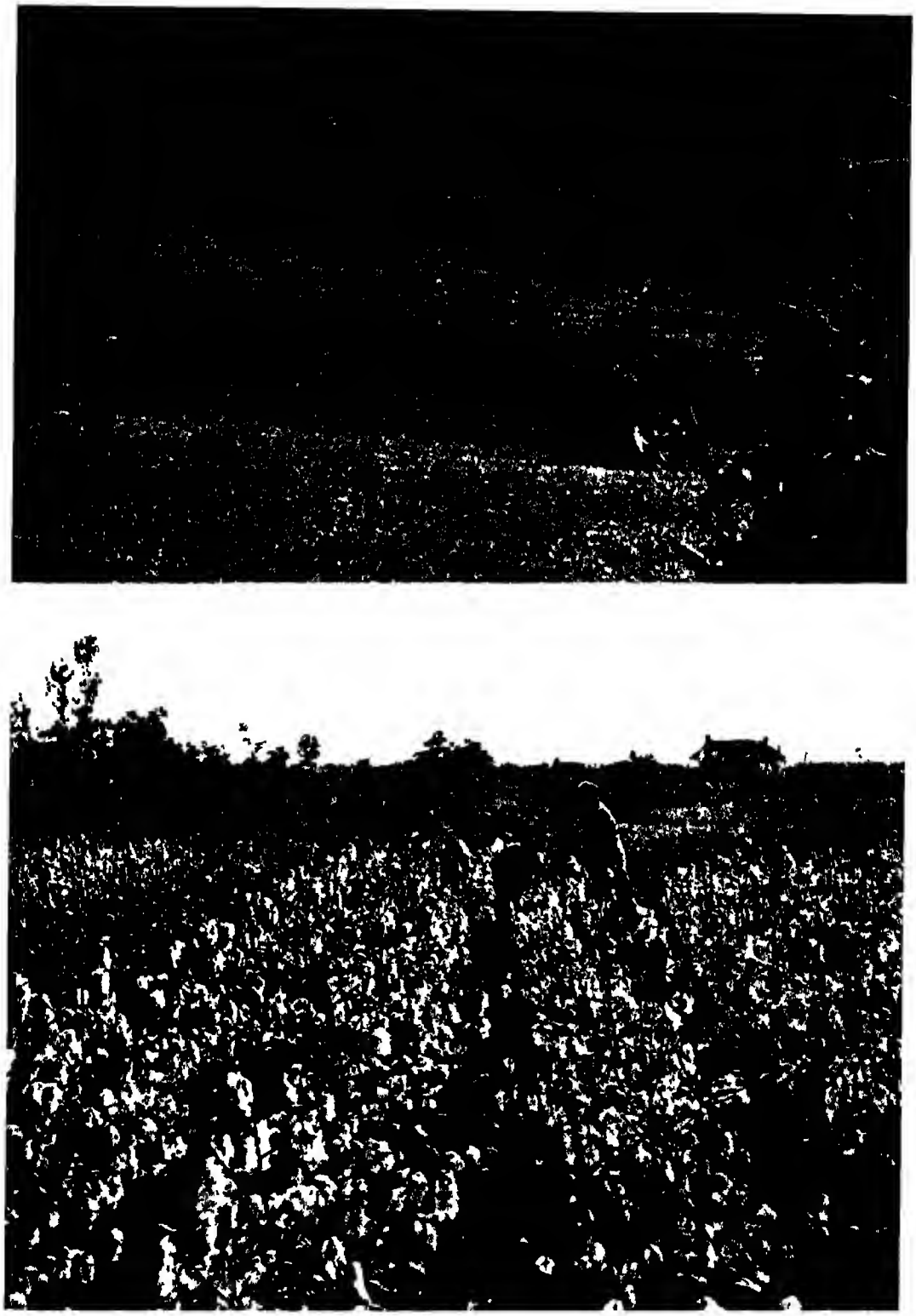

PLATE 11 Corn in the shock, typical fall scene wherever corn is grown. The field is strip-cropped to prevent erosion and increase corn yields

BOTTOM. A typical cotton patch in late fall. This one is in Mississippi; the leaves have fallen, and picking is just beginning.

PLATE 12. Cotton bolls emptied from field sacks to await being carried off to the gin. Inset shows a much enlarged cotton boll weevil, which should be about a quarter of an inch long.

chica, their national drink. Nearly every month of the year included a ceremonial that surrounded the sacred grain. At planting time and again at the harvest, the ruler of the Incas himself took part in the festivals, using golden tools to plant or harvest. But in spite of the great reliance placed on corn by the Incas, and in spite of the high state to which they had brought corn and its cultivation, these people do not seem to have known where corn came from. If they did, they kept the secret well. Studies of the Incan cultures may one day reveal the way in which corn came to the world, but so far they have not.

Some points in this mystery are clear. Botanists are certain that corn came from some part of the New World because there is no mention of corn in any of the writings of the Old World prior to the time Columbus discovered the West Indies. There was no Hebrew or Greek word for it; the Bible does not mention it; it has never been found in Egyptian tombs or pyramids or in the ruins of Assyria or Babylonia. There is no longer any doubt that it came either from North or South America; but where?

No explorer has yet found corn growing wild. A number have reported such a find, but the plants have always turned out to be something else. As a matter of fact, present-day corn has lost the ability to reproduce itself without man's care. Thus, if you plant a whole ear of corn, hundreds of seedlings will come up and some will grow vigorously, but crowded the plants are unable to produce seed before all of them die. Corn is so remarkably specialized that it has been called the world's most highly domesticated grain. It is a grass, but there is no other grass like it.

The peculiar thing about all this is that the most ancient corn we know of—dug from the graves of the very earliest peoples in the Americas—resembles our own corn so much that it cannot be called primitive. The corn the Indians were using, that the Aztecs had, that the Incas grew, and that the predecessors of all these

peoples had, was just about the same as the corn we grow. Remember that you cannot have corn simply springing full-fledged into being because you are faced with the fact that it cannot grow wild in the condition we know it.

Botanists have argued from such facts as these that there must have been, there simply had to be, a wild ancestor of corn. Acting on this idea, many plants that resemble corn in one way or another have been brought into experimental gardens to study. Some of them have been successfully interbred with corn, but the resulting monstrosities do not look like anything known in the wild state. In fact, these hybrids have shown rather clearly by their behavior that they had relatively little to do with the beginnings of corn.

The reasoning back of the final guess is rather interesting. Botanists argued that to make a truly wild plant out of corn, two simple things would have to be done to it. The first would be to develop some kind of a protecting cover for each grain, since the grains, as they are borne now, are naked. The second would be to develop some kind of a device that would permit the grains to break away from each other, so that the seed could actually be dispersed and have a chance to develop. Interestingly enough there was a plant fitting this description, but, unfortunately, it was one of the hybrids that occasionally appear in corn breeding experiments, and, as everyone knows, hybrids never breed true. But botanists were not discouraged. They set to work to see if they could breed a plant that would have the characters they wanted, but that would be able to reproduce itself. And they succeeded. They now know, within reason, what the wild plant should look like, and consequently what explorers should look for.

Next the workers reasoned that since corn does best in fertile bottom-land soils and since it is by no means resistant to cold weather, it would most likely have developed in a warm, humid,

perhaps sub-tropical region where there was plenty of rain, for corn is very easily injured by drouth. This sort of thinking pointed toward the upper parts of the Amazon Valley. So far this was old stuff. Many workers had arrived at nearly similar conclusions, but the rub was that there was no evidence that the primitive corn—called pod corn—ever existed in the region the evidence pointed toward. Very well, said the botanists, let us investigate the evidence; let us see whether pod corn ever grew in the upper Amazon Valley.

Sure now that the pod corn was primitive, they began looking for pictures, references in old manuscripts, accounts of explorers, of a plant that would look like the pod corn they had developed in the laboratory. Here and there they found reference to 'pisingallo,' a peculiar kind of corn from Paraguay and Brazil that had the seeds covered by a 'tunic' or covering. And they found at least one good representation of pod corn in clay dug out of some Incan ruins in Peru. Finally they discovered that the Jesuit missionaries of early days, following aboriginal tradition, always considered the peculiar 'tunicated' maize of Paraguay to be the original form of corn, and that the upper reaches of the Plate River in Paraguay were the original seat of corn agriculture. All this evidence looked pretty good.

The truth is that although the work that has been done is certainly excellent and very convincing, one final proof is still lacking. Until the wild ancestor can actually be found growing wild in the area the theory says it should be found in, the story will not be clinched. But all the data that can be assembled now points to the still unexplored lowlands of Paraguay, Bolivia, or southwestern Brazil. There, say the scientists, should the ancestor of corn be found; there explorers should look for a plant resembling what we know as pod corn.

There is, of course, a great deal more to the story than we have

written here. Much of it is highly technical and rests upon some very complex but neat work of plant breeders. Some of it depends upon the critical examination of old manuscripts, of early accounts, and of archaeological findings. All of it depends upon careful scientific weighing of evidence and rigid rejection of uncertainties. You can read it all, if you have time, in *The Origin of Indian Corn and Its Relatives*, Bulletin 574 of the Texas Agricultural Experiment Station, prepared by P. C. Mangelsdorf and R. G. Reeves, the two scientists whose arguments we have been following in our discussion here.

For the time being we may say that it looks as though corn came originally from the lowlands of Paraguay, Bolivia, or southwestern Brazil. After it appeared in the wild state as pod corn, it was taken up by savages of the jungle many thousands of years ago. Some of the more enterprising of the aborigines took it to the higher lands, and as agriculture itself developed, the many varieties of corn grew up with it. Eventually maize was traded between one tribe and another until it spread from Peru to Central America and Mexico. From Mexico it went to the American Southwest and then spread north and east over North America. Had the discovery of America been delayed a few thousand years, remark our Texas scientists, and corn been allowed to have its full effects upon the Indian culture, 'one wonders what a magnificent civilization might have been reared in the stimulating climate of the region now the northern and northeastern United States.'

## The Mastery of Corn

We have purposely devoted extra space to corn because it is most characteristic of the kind of agriculture that developed in the New World. No crop in Europe was grown in hills, as corn and potatoes are, but rather whole fields had to be cleared and cultivated to permit the broadcast sowing of wheat. Corn did not

require that all the land be cleared to grow it; all that was necessary was to clear away the brush, girdle the trees, and dig little holes to plant the grain. A good scratching around the young plants in order to keep out weeds would permit the corn plants to grow. In pioneer days, the settlers grew corn in hills just as the Indians did and as we do now. It is interesting to notice that the

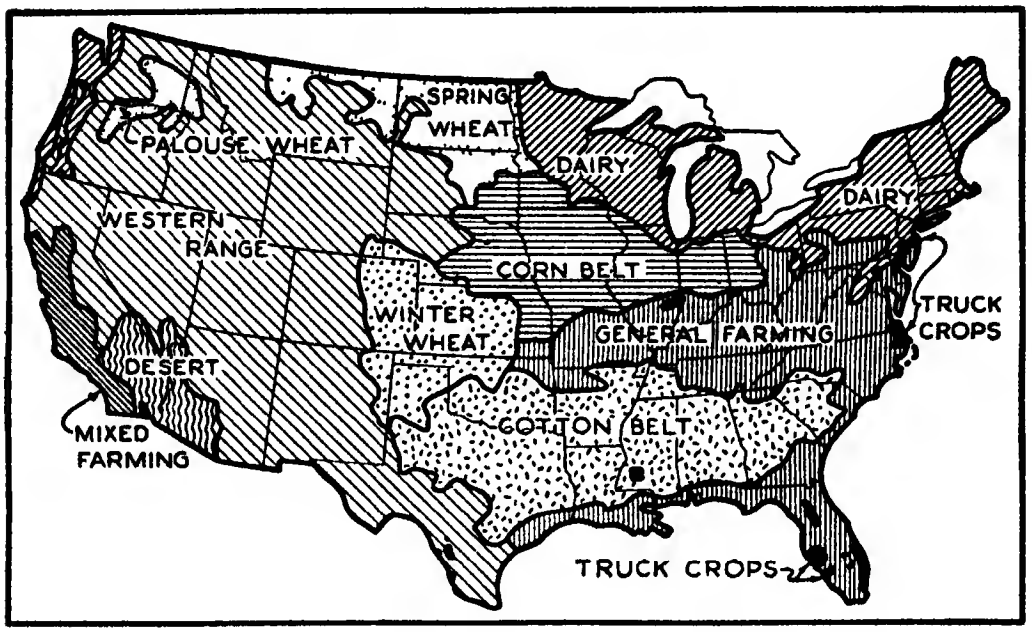


FIG. 1. Principal crop regions of the United States

most advanced experiments indicate that it may not, after all, be necessary to continue plowing the whole field in order to grow corn.

There are not a great many places in the world where climate and soil conditions are exactly right for growing corn on a commercial scale (Plate 10). The most important place is the famous Corn Belt of the Mississippi Valley in the United States (fig. 1). Iowa sits in the center of the Belt, and parts of all the States surrounding it, plus Illinois, Indiana, and Ohio, make up the rest. It is here that corn yields more grain per acre than in most other parts of the country. When the average over large areas approaches or gets

over 50 bushels for each acre planted—as it does in many Corn Belt States—you are really growing corn.

But Indian corn is grown in every State in the Union. The Corn Belt, for example, used to lie across Tennessee and Kentucky. In some southern States an enormous extent of land is used for corn—more in Georgia, for instance, than in the Corn Belt States either of Ohio or Indiana. But acreage of land supporting corn should not be confused with bushels of corn harvested. An acre of corn-land may produce 100 bushels, or 25, depending on how well the corn grows. Georgia is in the middle of the land of cotton, but it usually has twice as much land in corn, and there are other cotton States like it.

All of this leads us to an interesting consideration. It might be possible to grow all the corn the nation needs on a relatively small acreage of land *if* the land were high-quality corn land. Or, it might take a whole lot more land to grow all the corn we need *if* we grew all of it on land of low quality. In the story that follows, do not forget this. One of these days, some strange things may happen to corn and the land on which it grows.

## Hybrid Corn

There has been one remarkable achievement with the corn plant since the Indians gave it to the early pioneers. We are still in the midst of this remarkable development, but things have gone far enough so that we know we have surpassed the Indians in at least one respect. What we have done depends on what the Indians did to start with, but science applied to corn breeding has produced something neither the Indians nor the Aztecs nor the Incas ever dreamed of.

Before we proceed we need to know a few simple things about the way corn seed is produced. The first is that the sexes are separate on the corn plant. The second is that the tassel at the top

produces pollen, which is the male parent. The third is that the very young ear of corn is the female parent. And the last is that corn kernels will not develop unless pollen from a corn tassel reaches the corn silk hanging from the young ear. Thus:

Pollen (from the tassels) + very young kernels = ears of corn with mature kernels.

Corn pollen—the Gold Dust of the Corn Belt—usually blows about like dust in the wind and the luckier of the tiny pollen grains come to rest on the sticky corn silk more or less accidentally. The pollination of the ears is thus a matter of considerable chance, and it is a wise kernel indeed, figuratively speaking, that knows its own father. Both male and female parents contribute to the corn seed so that the kind of a kernel that results and the kind of a plant *it* produces depend on two parents. You cannot expect to get fine corn, for example, by planting seed from big ears, because the pollen may have come from a little runt of a male plant.

Herein lies the secret of the remarkable hybrid corn developed during the past half century. The whole trick lies in picking good parents for your corn. For seed you might pick the best ears—thereby getting good female parents—*but*, you need also to be sure that the pollen came from a good plant. Seed from beautiful ears of corn will produce some plants with good ears, but if the pollen came from a runt, many of the plants from apparently good seed will also be runts.

Scientists were not the only ones concerned in this matter. A farmer in Tennessee, back in 1867, decided that it took two plants (the male and female parents) to produce an ear of corn. He saw to it in his special seed patch that any corn plant that did not look as though it would produce at least two ears had its tassels cut off. In this way he let no pollen get into the air that did not come from a really productive plant. And year by year his corn improved

until it finally came to the attention of corn dealers, who urged other farmers to try the same thing.

Scientists proceed somewhat along the same lines in breeding new corn (Plate 10). In addition, by proper experiments, more technical than we need to consider here, they work on the parents until they will always breed true for certain characters needed. When the pedigree is clear, the breeders cross a male parent and a female parent to produce seed for planting, which results in better corn than anyone believed possible years ago.

Depending on its parents, the new hybrid corn will produce up to 35 per cent more grain than ordinary corn. It stands up better, has more shapely ears, neater arrangement of kernels, and more uniform ears. It is more resistant to diseases and pests than the ordinary corn. Its ears are produced at more uniform levels on the stalks, so that harvesting is much easier. Like fine cattle and horses, corn can now be made into the kind of plant we want. We can, so to speak, make a race horse or a work horse out of it, whichever we want.

Most of the corn grown in the Corn Belt is now hybrid corn. As breeders move forward with their work, eventually most of the corn in the entire United States may be of this type. You may not be able to tell by looking at it whether a field of corn is hybrid or ordinary. However, if most plants have two to three ears all about the same size and height from the ground, and if there is no disease and the plants are vigorous, the chances are good that the plants are hybrids, especially if you are in the Midde West. So far the South does not have much hybrid corn, although breeders are trying hard to get some for it.

One more matter should be explained. Hybrid corn does not produce seed that will come true. Every year the new corn planted has to come from careful crosses made in seed farms. No use saving seed. A hybrid produces plants like the parents, but not like

the hybrid. The parents of hybrid corn are never superior in all ways, only in certain ways, which, when combined, make for the remarkable new product that is revolutionizing the corn agriculture of the country.

## The Growing of Corn

Corn is a plant the botanists call a summer annual. This means that it sprouts in the spring, grows rapidly in warm summer weather, and goes to seed at the end of the season. We plant it in regularly spaced rows 1 to 4 inches deep, and cultivate it carefully during its early stages to keep weeds from choking the young plants. When the plants are vigorous enough to go ahead by themselves we 'lay the corn by,' as farmers say when they are through cultivating it. 'Knee-high by the 4th of July' the corn must be, say the Corn Belt farmers, if it is to produce properly.

At the end of the season the ears may be picked off and hauled away, leaving the old stalks standing in the field to be eaten by cattle. Or, the stalks themselves are cut and stacked wigwam fashion to let the grain ripen further (Plate 11). The sweet corn you eat from the cob is unripe, and is picked early, when the kernels are soft. Ripe corn kernels are hard and can be stored in well-ventilated bins, or corn cribs as they are called, for a long time.

Corn can be very hard on soil. If it is grown on hillsides and the rows run up and down hill, every rain sends muddy water coursing down the rows. Tons of good soil can be lost in this way in a surprisingly short time—perhaps only a few hours. If the rows are run *around* the hill on the level, the water does not run off so easily. There is more about this trouble in Chapter 15, and how to stop it comes in Chapter 16. Here we should note that growing corn in a slipshod way can ruin good farmland about as quickly as any crop we know.

## What We Get from Corn

In one way or another we eat about 16 bushels of corn per person in the United States every year. This does not mean that we eat it directly; we may eat it in the form of pork or beef that was produced from corn-fed pigs or cattle. Between 5 and 6 pounds of corn fed to hogs will make a pound of pork, for example. The famous corn-hog agriculture of the Middle West comes about because the hog is the principal direct consumer of corn. Indeed, the pork industry depends almost entirely upon corn, using about 40 per cent of the total crop. But many domestic animals other than cattle and pigs are fed on corn, and corn is fed in other ways than as grain. Green corn packed in bins known as silos, and fermented, is good cattle feed. So is corn stover—the cornstalks after the ears are taken off in the field.

Actually, corn is a principal source of food in this country whether we use it directly or indirectly. Corn may reach the table as cornbread, hominy, corn meal mush, corn whiskey, or 'on the cob.' It may be poured on corn cakes in the form of corn syrup, sprinkled on fruit as sugar, or put on salad as the oil base in the mayonnaise. The crust on bread may have been painted with corn dextrin to give it its soft brown color, and ice cream, candy, and even chewing gum manufactured in part from corn products may conclude many an American dinner.

If you like figures—we produce over a billion pounds of cornstarch annually, nearly half a billion pounds of corn sugar, almost a billion pounds of corn syrup, and some 60 billion pounds of corn oil, oil cake, and corn meal. We use the sugar in sparkling ales and in dyeing processes. The gum on the back of postage stamps comes from corn. Many manufactured jellies and preserves are based on corn syrup. Pith from the cornstalks is made into explosives or used for packing, and the husks from ears of corn are

used in cheap mattresses. A fine grade of charcoal comes from corn cobs, as do the corn cob pipes. A coarse paper is made from cornstalks, and corn oil is used in certain soaps, paints, and rubber substitutes. Popcorn is too well known to require comment, and cornstarch is a common product on grocery store shelves.

But for all its excellent attributes, and in spite of its tremendous importance, corn remains a dangerous crop for certain soils, requiring great skill and care in growing. Agricultural workers are concerned over the great soil destruction that accompanies corn growing. Some of them have even gone so far as to suggest that we may, in self-defense, have to do away with corn altogether or pay more attention to our inefficient ways of growing it. Whether corn remains a heritage or becomes history lies in the future of a strangely changing world.

## V

# COTTON BOLLS AND FLAXSEED

In autumn and early winter, all through the South the roads are festooned with cotton. You can see wisps of it sticking in the low hanging branches of trees, caught out of passing wagons. Shreds of cotton blow from the tall weeds and roll in windrows along the road berms. Little square wagons full of cotton roll slowly toward the cotton gins, pulled along by a mule or two 'driven' by a darky relaxing in the soft load. In the fields are the brown remains of the cotton plants, and here and there a great gray-white pile of cotton not yet hauled away. Cotton spills off the sharecropper's front porch or from the doorway of the shed in his yard. Big trucks swing importantly along the highways, carrying cotton bales that threaten to fall off on every curve.

But the South wasn't always a land of cotton, and it didn't always grow the tremendous crop of cotton it does now. To be sure, the early colonists began planting cotton very soon after they arrived in the New World. Cotton-growing spread with settlement, and a hundred years after the earliest colonies, cotton began to be shipped in small quantities to Europe. But people in the South were discouraged even so, because making cotton really pay seemed hopeless. For a long time, the cotton lint had to be picked off the seeds by hand—which is a most laborious process—or pulled off by crude machines of an ancient type used for centuries in India. It took eight or ten hours for a man to clean a pound or two of cotton by hand, and the labor of forty slaves for two months to clean as much as might be raised by a good field hand in a season.

Because of this bottleneck, cotton production on any sizeable scale was impossible.

Had it not been for a chance meeting on a boat trip, perhaps cotton never would have become important. But in 1793 young Eli Whitney, on his way to South Carolina to teach school, fell into conversation with the widow of General Nathanael Greene of Revolutionary fame. Later Mrs. Greene invited Whitney to her plantation near Savannah, where the Yankee teacher became interested in the problem of picking cotton lint from the seed. In ten days' time in Mrs. Greene's basement workshop, Whitney turned out a home-made machine that would do the work of a dozen slaves. With some improvements and the use of power, the new machine—known as a cotton gin—at long last made it possible for cotton to come into its own. The bottleneck was broken.

A hundred years after Whitney invented the gin, we were growing 20 million acres of cotton, and every ten years thereafter the land devoted to cotton was increased by about 5 million acres. We reached our all-time high in 1925, when we grew almost 46 million acres of the plant. By now we grow only about half that much because of a number of world conditions that have made it difficult for this country to export cotton.

In the meantime something else happened that came near creating another bottleneck in growing cotton. A little beetle that lived on the wild cotton of Mexico crossed the Rio Grande about 1892 down near the southernmost tip of Texas. It was a very small insect, not much more than a quarter of an inch long, and a nondescript yellow brown to dull gray in color. Technically the beetle was known as a weevil because of its very long snout. It laid its eggs in little holes made with the snout in the base of the cotton flower bud, and its favorite food was the pollen inside the unopened flower.

Well, when the little weevil crossed the Rio Grande in 1892

there lay before it about 19 million acres of its favorite food. It multiplied rapidly and during the next eleven years succeeded in working its way up the coast of Texas to Louisiana and north almost to Oklahoma. Four years later it crossed into Mississippi, and in 1909 it got as far as Alabama. At the start of the First World War it was entering Georgia, and at the end of the war it was well into South Carolina. To make a long story short, in less than 30 years, the cotton boll weevil spread into nearly every portion of the Cotton Belt, and wherever it went it spread disaster. Hundreds of millions of dollars' worth of cotton fell before the dainty appetite of a tiny little weevil.

The boll weevil is still with us, and in some places it is a great deal more destructive than in others (Plate 12). All kinds of methods to prevent its doing serious damage have been developed. For one thing, cotton that produces its cotton bolls early in the season has largely taken the place of cotton that matures late. As one entomologist puts it, the production of cotton in the presence of boll weevils is nothing more or less than a race between the maturing of the cotton bolls and the multiplication of the weevils. The faster the cotton grows, the more chance it has of winning the race. Another important measure is the destruction *before* frost of the old cotton plants so as to deprive the weevil of a place to spend the winter. If you visit the South, you can see for yourself that this last measure is widely neglected—there will be plenty of fields all winter full of old cotton stalks. This is partly because cotton cannot always be picked before the first frost, but cotton stalks stay in many fields because of indifference on the part of the owner and his tenants.

## The Origin of Cotton

Cotton is another of the crops that have been cultivated since prehistoric times. Nobody knows when it was first woven into

cloth, but cotton cloth has been dug out of ruins in India that date back to 3000 B.C., and there seems no doubt that the ancient civilizations of South and Central America used cotton before the Christian Era. Columbus found cotton growing in the West Indies when he discovered those islands, and Cortez and Pizarro found it in use in Mexico and Peru respectively, when those Spanish plunderers destroyed the civilizations of the Western World.

There is an interesting point concealed in the paragraph above. Cotton was being grown and woven into cloth in *both* the Old World *and* the New—long before there was any connection between the two hemispheres. This is a very remarkable fact. Wheat came wholly from the Old World; corn came wholly from the New; but cotton came from both.

Scientists who have studied the problem for many years are agreed that there were at least two, and possibly four centers of origin for the cotton plant. Hindustan and Middle Asia for the Old World, Central America and northwestern South America for the New World, seem to be the places, although wild cottons are known in other parts of the world. Interestingly enough, Asiatic and American cottons have remained distinct ever since their origin. Ordinarily they will not cross, and if they do, the plants produced are sterile hybrids.

All the cotton we grow in this country is American cotton, even though the varieties we use are the result of many generations of crossing and hybridizing. Some of the cotton we grow in Arizona came from Egypt, but the Egyptian strains came first from the other side of the world, probably South America. The famous Sea Island cotton, which has such a long fibre, is also believed to have originated in South America. The cotton we grow in the uplands of the South—upland cotton—came originally from Mexico or it may have arisen from crosses between Mexican and South American cottons.

We could go into a mass of detail about the cottons we grow in the United States, but there would be little point in doing so. Even the experts agree that the botanical history of most of our varieties is a puzzle that may never be solved. Our cottons are all from somewhere in the New World, and they are certainly mixtures of many kinds. Beyond this there is not much to go on. It is worth mentioning, at least, that cottons from the New World are becoming increasingly important in the Old World, even where the Asiatic cottons originated. Russia grows American cotton, so does Egypt; the best cotton in China came from the New World; and in India, where Asiatic cotton is grown the most, American cottons are coming into greater use all the time.

## Growing Cotton

Very early in the spring farmers may start using 'middle-busters' on their land to get it ready for planting. Cotton will not do very well in land that is too wet, so that it is usually planted in little ridges, and you use a middle-buster to bust out the middles between the ridges. This is not slang, even though books describe the process as middle-bursting, but is what southern folks call it, and they ought to know. A middlebuster, then, is a plow that throws dirt on both sides, out of the middles between the future rows of cotton, and it is very widely used in the South.

Cotton-planting time comes in March in the Deep South, or later as you go north, so that it may be June before some cotton gets in. But wherever cotton is planted, a lot more seed is sown than would really be needed if every seed made a plant. The farmers take no chances, because a lot of unfortunate things can—and usually do—happen to young cotton plants. Hence, when cotton comes up the plants are usually closer together in the row than they ought to be, and many of them have to be taken out. Folks do this with a hoe, and this process is what they mean when

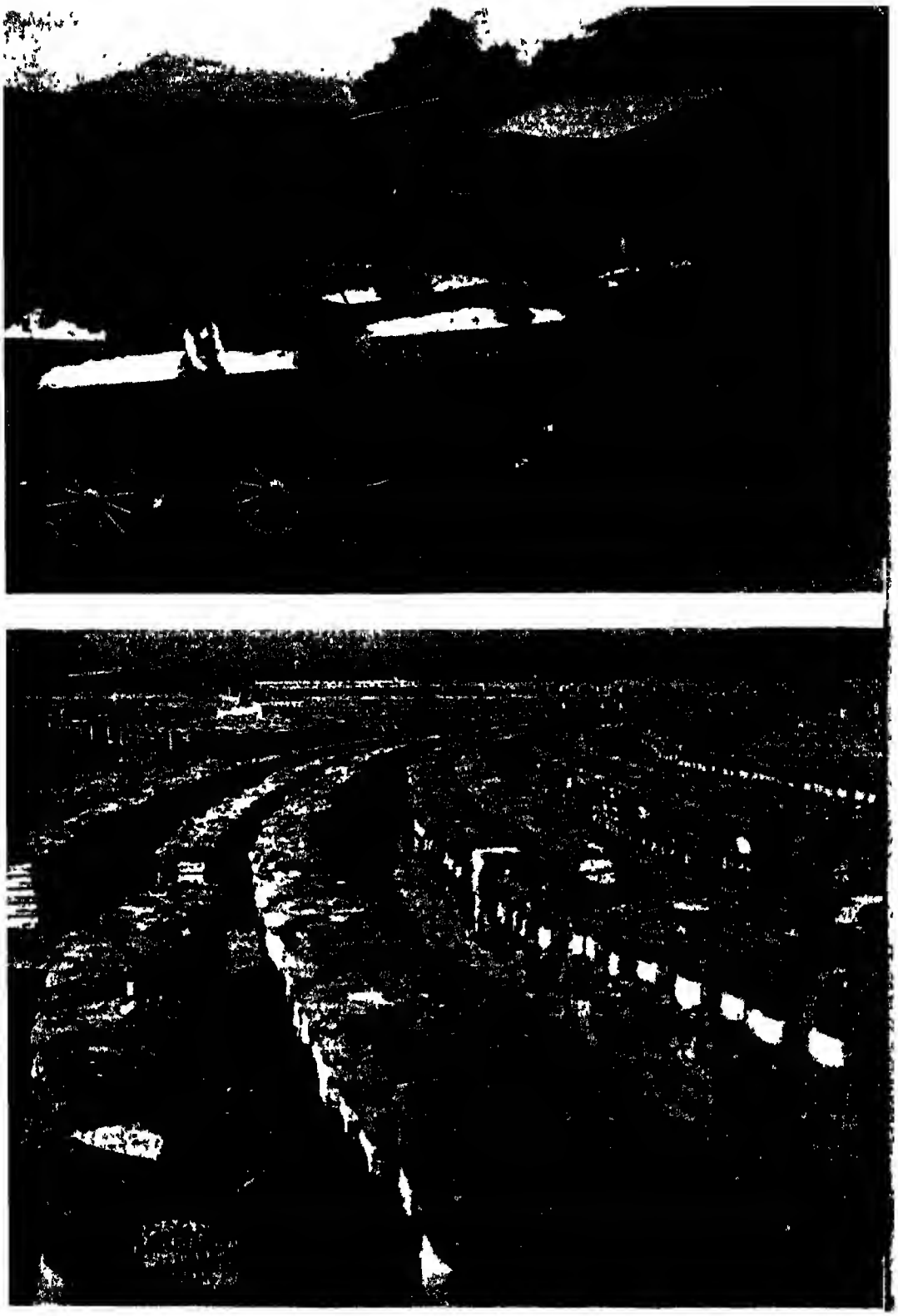

PLATE 13. Typical cotton wagons pulled by mules wait to unload at a local cotton gin in Georgia.

BOTTOM. Bales of cotton from productive Texas fields awaiting shipment.

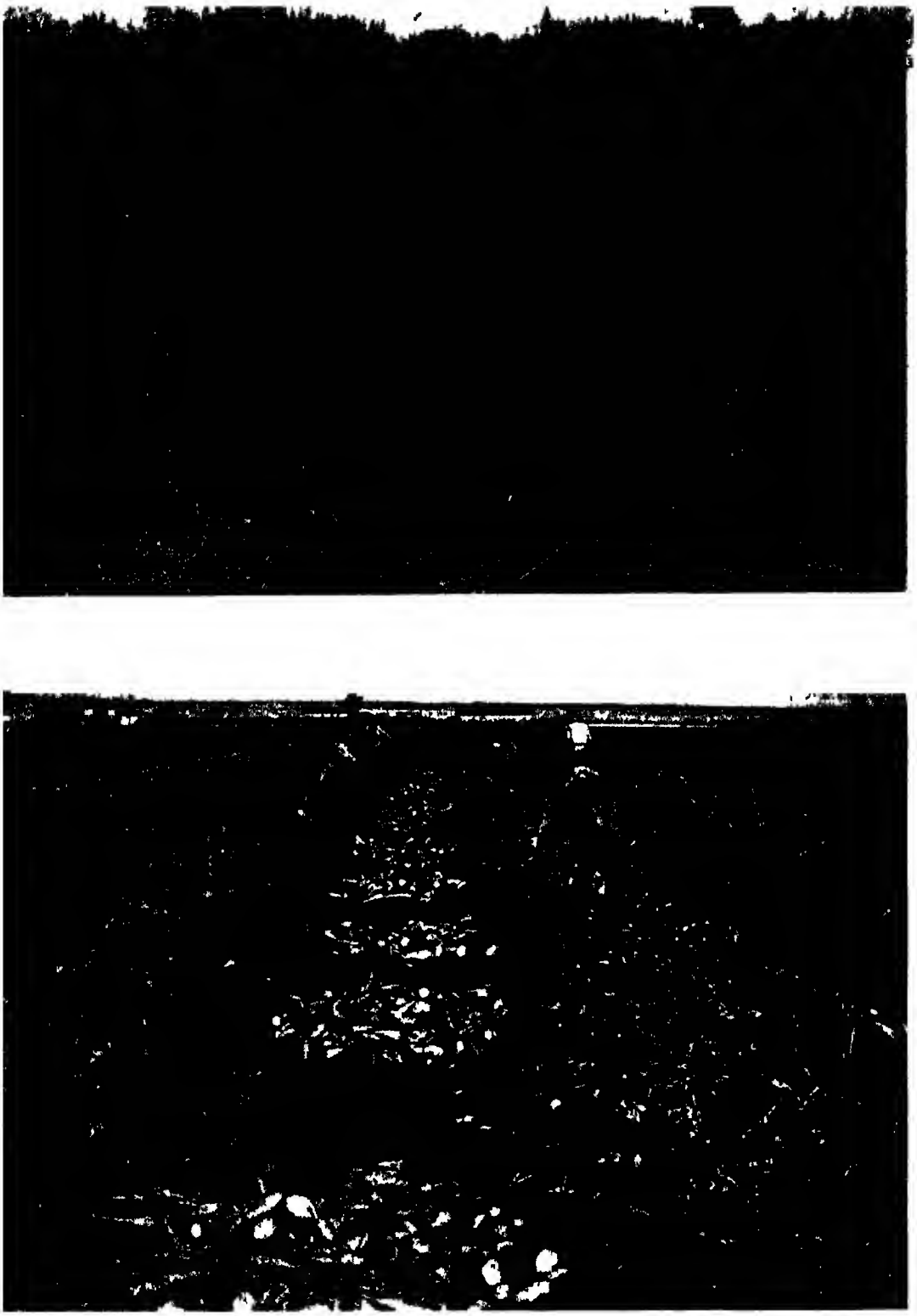

PLATE 14 Flax shocks in an Oregon field awaiting threshing The little globular capsules contain the flax seed. Note the scrap of original timber in the background.

BOTTOM. Sugar beets in a Colorado field. Tops are being cut off and thrown aside; roots go to the refinery.

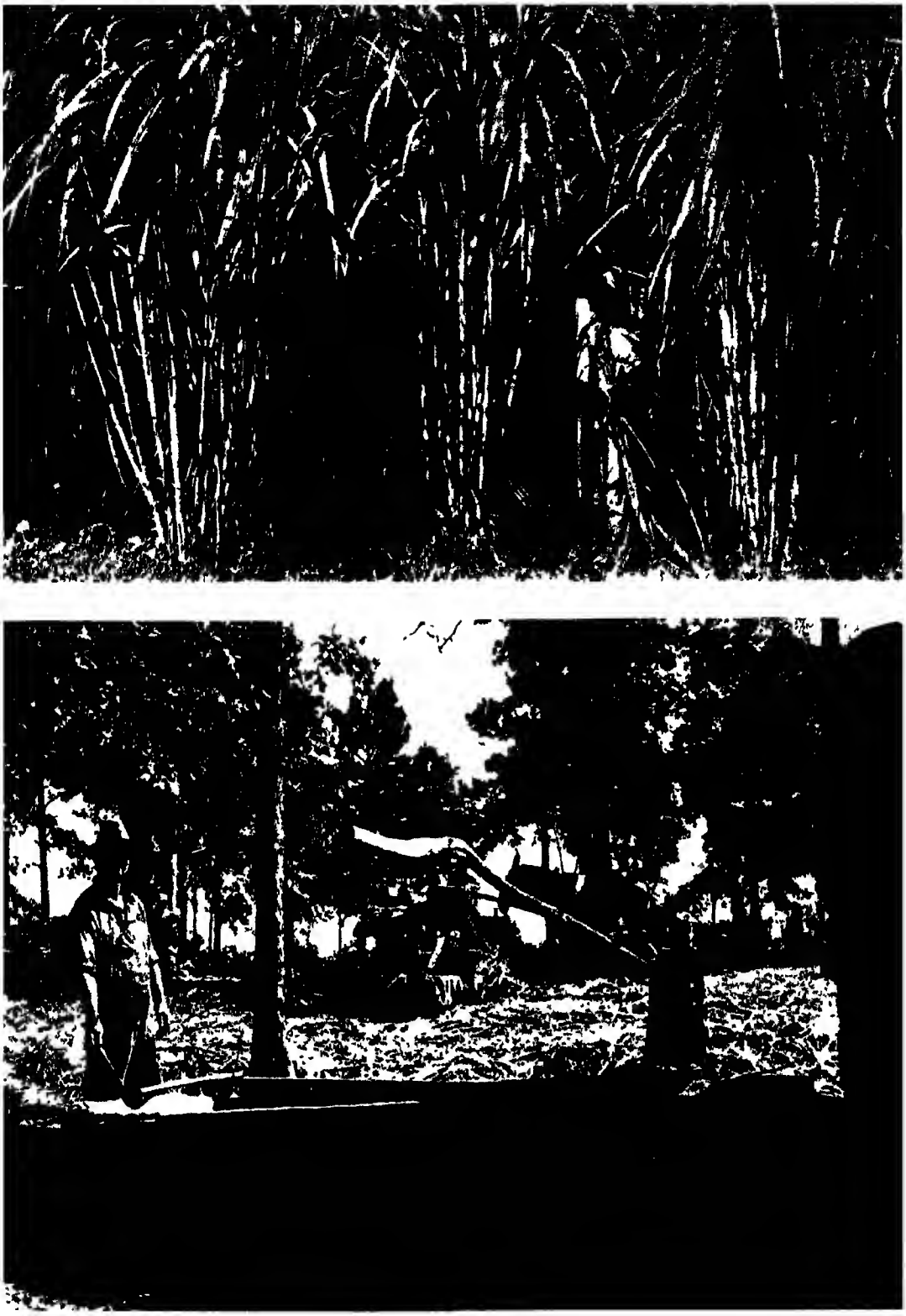

PLATE 15. A good stand of sugar cane in a South Carolina field.

BOTTOM Making molasses in Alabama. Cane is crushed as the mule turns the mill. The juice is collected, concentrated in the evaporating oven in the foreground.

PLATE 16. An apple orchard in full bloom.
BOTTOM. Pear trees, with characteristic high-reaching branches

they talk about 'chopping cotton.' After the cotton is chopped, it has to be cultivated or hoed several times more until the plants are in full bloom and producing young cotton bolls.

A cotton field in bloom is a beautiful sight. The big flowers look very much like hollyhocks or hibiscus—to both of which cotton is related—and they are a rich cream-yellow in color, often tinged with pink. Cotton keeps right on flowering even after cotton bolls are opening on the lower portions of the plant—which is a good thing, because as long as there are enough flower buds for the boll-weevils to eat, they will not attack the young cotton bolls very seriously. If you look for them, you can usually find a few flowers on old cotton plants even in midwinter.

When there have been enough cultivations and hoeing, the cotton is 'laid by.' This means that the farmers 'lay by' also, to wait until the cotton is ready to pick. Eventually the cotton bolls pop open and the snow-white cotton lint pushes out of the pods. The fields are still green, and at a distance seem to sparkle as the leaves move in the wind to hide, then to reveal the cotton. As the leaves age and wither, and more bolls open, the fields get whiter and whiter, and finally the cotton pickers begin to appear (Plate 11).

Cotton picking takes a great deal of skill and a lot more endurance than you might suspect. The lint has to be pulled clean in a quick grasp or two, from the open pod, and you have to bend over all day long. You have a long bag slung over your left shoulder and as you stuff cotton into the bag, you drag it along on the ground behind you. If you are a fair picker you will finish the day with about a hundred pounds to your credit (Plate 12).

Most of our cotton is picked by Negro women and children, whose muscles seem to be hardened to the work. All the same the work is hard, which is one reason why mechanical cotton-pickers were invented. These machines are in use, but not commonly;

some of them strip the cotton, some suck it in by means of a vacuum, others operate in different ways. So far, however, none has been good enough to replace the experienced hand-pickers.

Where labor is scarce, cotton bolls may be picked off entirely—pods and all. This kind of cotton has to have special treatment to get the burs off. 'Snapped cotton' this is, and lower grade because the fibre is beaten so in the cleaning process. Then, if frost comes early, some of the bolls won't open, but these are picked anyway and put through a cotton gin with a special attachment that breaks them open. This kind of cotton is what people call 'bollies' or 'bolly cotton.'

## What We Get from Cotton

After cotton is picked, it still has to go to the gin, where the lint is pulled off the seeds and put up in big bales weighing about 500 pounds apiece (Plate 13). You are likely to see these big bales standing on loading platforms or in the gin yards almost anywhere south. We produce about 13 million of them yearly—some years more, some less. And it is the cotton fibre that we use to make cotton thread, then cotton cloth, for all the wide uses well known to everyone.

The seeds of the cotton used to be piled up to rot, or they were dumped into the river—before the Civil War, that is. A little seed was saved for planting and some was used for fertilizer or cattle feed, but mostly it was a nuisance. Some States even passed laws about it, especially where the rotting piles of seed were near towns. But when the chemists struck oil, so to speak, in the worthless cotton seeds, things began to change. The seeds became important as soon as we learned how to get cottonseed oil from them, and the oil and other seed products are now among the main assets of the South.

The fuzz that clings to the seeds—cotton linters—is taken off

the seeds first. Linters are used principally to make explosives and for stuffing mattresses, but they have other uses. They may turn up in cushions, horse-collars, or upholstery; they are turned into felt or are mixed with wool to make fleece-lined underwear; candle-wicks, twine, rope, and carpets may contain cotton linters, and they are the basis for one type of very fine rayon, and for certain kinds of paper.

After the linters, the seed hulls come off. They make fair cattle-feed. Next the oil is pressed out of the cooked seeds by hydraulic presses capable of exerting a pressure of two tons per square inch. The oil is carried away to appear later in a bewildering variety of things. It is used in such diverse things as putty, cosmetics, salad dressing, lard, soap, grease, washing powder, roofing tar, oilcloth, artificial leather, and for packing sardines. The chemists can really do wonders with it, as the list can testify, and they have more than a billion pounds of it to work with each year. But this is not all.

After the oil is squeezed out of the seed, cottonseed meal is left in the press, and cottonseed meal is rich in proteins. Hence, as one might surmise, the meal makes a fine food for cattle, and most of it is used that way. All in all, for a worthless cotton seed, the list of uses is very remarkable, and the industry dependent on it is enormously valuable.

## Flax

The story of flax was originally put with that of cotton because both plants produce fibres; that is, here in one place is the story of fibre plants on the land. But notice that we just finished talking about cottonseed oil, which bids fair to become more important than cotton fibre. Then notice that although we used to grow flax for its fibre, we now grow it principally for its oil. This may be a coincidence, but at any rate our fibre chapter seems to be turning into an oil chapter after all.

Flax seed oil—better known as linseed oil—is very important to

the paint and varnish industries, as anyone knows who has ever mixed paint about the house. In this country we devote about 3 million acres to growing flax and gather upwards of 30 million bushels of seed to make about 700 million pounds of oil. And as with cotton, we feed the flax seed meal to cattle because it has a high protein content and a very beneficial effect on the animals' insides.

Where the flax plant came from originally the scientists cannot say. They believe it may have come both from the Near East and the Mediterranean region, but they are shy about stating this as a fact. The trouble is, of course, that flax is another crop that has been cultivated so long and spread so widely that determining its original home is almost impossible. The oldest European civilizations of which we have any record were using flax; the Egyptians wrapped their mummies in linen, and the old Romans made their togas out of it. For at least 5,000 years flax has been used either for its fibre or as a food, or for its oil.

Flax got a good start in the American colonies very shortly after settlement began. It was grown for its fibre, from which linen is made, and the States of New York, New Jersey, and Pennsylvania were exporting it in 1770 as a staple article. But other happenings, some of them apparently unrelated to flax, took place, and the whole history of flax in this country changed radically. Eli Whitney invented the cotton gin, which made it possible for cotton to compete strongly with linen, and about the same time linseed oil began to be manufactured in Pennsylvania and New York. Since that time we have grown flax principally for its seed. Since that time also, flax growing has moved from the East to the prairies, and from the beginning of this century Minnesota and the two Dakotas have grown most of the flax this country produces.

For a time, flax growing in this country was on the verge of being wiped out. When flax was grown year after year on the

same ground, eventually it would begin to fail, and finally it wouldn't grow at all. Putting on fertilizer made no difference, and workers were at their wits' end over the matter. At the North Dakota Agricultural Experiment Station there was a certain experimental flax plot—No. 30—that had been watched for about seven years. During that time the flax got poorer and poorer, and in 1900 no more could be grown on it; the plants would die before they reached three inches in height.

At that time the plot was turned over to H. L. Bolley, botanist at the Station, in the hope that he might be able to do something about it. Bolley discovered that the cause of the trouble was a wilt-producing fungus that lived in the soil. As the fungus increased, the soil became 'flax-sick.' Then Bolley performed a remarkable experiment. He deliberately started planting flax on flax-sick soil and although nearly all the plants died rapidly, now and then one would survive. Bolley took the survivors and bred and increased them, and finally succeeded in developing a strain that would grow and fruit and thrive on the fungus-infected soil. On old plot 30, given up as hopeless in 1900, flax has been produced now for 40 years, fine flax, as good as you can find anywhere. This strain it is that is our principal flax crop in the important flax-growing areas.

The flax crop is grown very much like wheat. The seed is planted by grain drills, the plants are cut and tied with a grain binder, the bundles are stacked to dry in the field, just as the grains, and the thrashing is done by grain-thrashing machines (Plate 14). Where there is a big enough acreage, combines are used, just as they are for wheat. But a field of flax looks very different from a field of any cereal, and when it is in bloom it may become a sheet of sky-blue flowers.

You can see flax growing in a good many States, especially those west of the Mississippi. In the central States and the Northwest,

considerable flax is grown, and in Michigan and Oregon some is grown for its fibre. To get flax fibre, the straw is spread out in the fields until the dew and rains have, as the growers say, retted the straw. The straw is sometimes retted by soaking in water under exact conditions of time and temperature, but the end effect is much the same. Then, with appropriate machinery the straw is broken and 'scutched' to separate the fibre from the bark and stems, and the crude fibre is baled ready to make into linen. We grow exceedingly little flax for its fibre, and although a number of efforts have been made to revive the fibre industry, today flax is almost entirely an oil crop.

But the oil is very important. We use it to make linoleum, oil cloth, patent leather, and to waterproof raincoats, as well as for enamels, paints and varnishes. And we have a series of words to use for flax products that comes from *Linum*, the old Latin name for flax—linseed, linen, linoleum, lint, and line.

## VI

# SUGAR FROM SOIL

From the root of a beet, the stem of one grass, the seed of another, and the bole of a forest tree comes most of the crystalline sugar we use. Beet sugar, cane sugar, corn sugar, and maple sugar are all exactly alike chemically and no matter how expert you may be, you cannot determine the source of the refined product by tasting it. But we get sugar in other ways than as a crystalline material. From sweet sorghum we get sorghum syrup and from sugar cane, molasses; from cornstarch we get a table syrup like karo; bees provide us with honey; from maple trees we get maple syrup; and from a number of other plants we get various sugars of value in certain kinds of special diets.

About two-thirds of the ordinary sugar we use is brought into the United States from foreign countries and our island possessions. Most of our own sugar comes from sugar beets, with sugar cane in second place. Roughly speaking we produce about four pounds of beet sugar for every pound of cane sugar and half pound of corn sugar.

### Sugar Beets

In Europe for many centuries farmers had been growing coarse-looking roots they called mangel-wurzels or mangels. The roots were fed to cattle, or, in hard times, eaten by the people themselves, and besides this, the peasants in certain sections used to use these mangels to make a table syrup. In 1747 a German chemist, Margraf, discovered that the mangels contained a sugar identi-

cal with that obtained from sugar cane. But not until nearly 40 years later did anyone do anything about it.

Toward the end of the eighteenth century, several attempts were made in Germany to start a sugar industry based on the mangels, or sugar beets, as they came to be known. The trials were a fair start, but they were not commercially successful. The methods of handling the sugar beets were fairly well worked out, and some strains of sugar beets were developed that contained more sugar than the ordinary mangel-wurzels. After that, attempts were largely abandoned.

In the meantime Napoleon got the idea that if he could produce sugar from sugar beets, he could strike a blow at the British trade in sugar from the British Colonies. He subsidized sugar-beet factories and ordered his people to grow large quantities of sugar beets. In fact Napoleon made such a point of the sugar-beet business that he succeeded rather well in making himself ridiculous to the people of his own time. After all, sugar was supposed to come from sugar cane, not mangel-wurzels. One cartoon of that period, for example, showed Napoleon dipping a mangel into his coffee to sweeten it.

But even Emperor Napoleon failed to get the sugar-beet industry going, and interest in it lagged for some years. Finally about 1829 it revived in France, then six years later in Germany. Men began to breed better beets, the manufacturing companies put themselves on a better footing, and the sugar-beet industry was under way. In the United States, some early attempts were made about the same time, and although our first sugar beet factory was set up in California in 1869, not until 1879 did the industry really become successful.

By this time a sugar beet is something quite distinct from a mangel-wurzel. In other words, this crop plant of major importance has been developed within the last 200 years. There are not

many crop plants that can claim such recent distinction. In this country every year we use close to a million acres of land for the beets, and from them we get 10 to 12 million tons of beets and eventually about 3½ billion pounds of refined sugar. Most of the present acreage is in the Rocky Mountain region, the Pacific Coast, and in Ohio and Michigan, but we could, if necessary, expand the sugar-beet area enormously.

The development of this great agricultural enterprise was not without its difficulties. To start with, we obtained our sugar-beet seed from Europe. But as usual, when a plant is taken from one part of the world and grown in another, things do not always go as well as they should and so it was with the beets. In this country we have some diseases that Europe does not have—'curly-top' for instance, and 'leaf-spot,' which doesn't amount to much in the places where sugar beet seed came from. Consequently, ever since 1900 American growers have been demanding sugar beets that would not catch these American diseases. But Europe obviously had no need to breed such beets, and nothing came of the growers' demands until we took up the problem in this country.

New strains of sugar beets have now been developed that are resistant to 'curly-top,' a disease that has caused heavy losses in the past; and new beets that can resist 'leaf-spot' have also been bred. In the meantime a seed industry has come into being in the Southwest, where we produce not only the ordinary varieties, but increasing quantities of the disease-resistant types. Breeders are also at work developing sugar beets that can withstand drought and cold, that will grow well in the humid East, that will not 'go to seed' too soon, and so on. There is, without question, a future for the sugar beet that might have seemed fantastic 200 years ago, when the simple peasants of central Europe used the coarse old mangel-wurzels to make a table syrup.

We grow the sugar beets from seed, thinning out the young

plants so that they are eight or ten inches apart in the rows. With machinery we carry on the weeding and cultivation all well-bred sugar beets must have. In late fall the roots are pulled out, the tops cut off, and the beets stored for processing (Plate 14). The extraction of the sugar is a long process, but essentially it goes like this: The beets are cleaned, cut into strips, and heated in running water. The sugar is dissolved out by the water, and after various chemical processes and filtering to eliminate impurities, the liquid is concentrated—that is, boiled down—and the crystals of sugar that form are taken out by whirling the thick syrup in centrifuges that permit the liquid to escape but retain the solid sugar. By-products result all along the line. The beet tops are used for cattle feed or fertilizer; the pulp, after the sugar is dissolved out, is used for cattle and sheep food; the impurities filtered out are used for fertilizer, and the thick liquid left after the sugar is centrifuged out of it—the molasses, in other words—is used for industrial alcohol or for stock feed.

The older strains of improved mangel-wurzels contained 5 to 7 per cent sugar. In the hands of the breeders the sugar content mounted, reached about 10 per cent by 1870, 14 per cent by 1890, and by 1912 the beets were averaging almost 19 per cent. There, authorities say, the figure has remained up to the present time, and there it is likely to stay until breeders can scare up new strains of beets to cross and interbreed with the types we now grow. When they do, we may expect higher yields than ever before.

## Sugar Cane

Nobody knows where sugar cane originated because, like corn, it has never been found growing wild. There are, to be sure, some wild species of cane that resemble sugar cane a good bit; these grow in the cluster of islands we call the East Indies. It is altogether possible that sugar cane itself came from the same general

locality, but it has been cultivated for at least 2,000 years, or probably more, and has changed enough so that its early identity may never be discovered.

The great grass was used in India before the Christian Era, reached southern Spain in the eighth century, and Louisiana in 1751. For many hundred years the plant has been grown in the wet tropics and subtropics of the New World, and for a much longer time, of course, in similar regions in the Old World.

For nearly 2,000 years nobody did much about improving sugar cane in a systematic way. People seemed to be pretty generally satisfied with the cane they had. But as more and more land was devoted to growing cane, a number of things began to happen. A swift-killing disease struck the plants where they were being intensively grown in the French islands of Reunion and Mauritius, and the crop of 1840 was wiped out. Again, 32 years later, the Puerto Rico crop was almost entirely destroyed. Beginning in 1880 the Java cane fields were afflicted with a disease that bid fair to do away with the industry. In the meantime competition between the many countries growing sugar cane was becoming more and more serious. Finally, breeders began to work at the problem of developing strains that would not go down before the legions of disease and that would yield more sugar.

In our own country the sugar industry of the South, where all our sugar cane is grown, was nearly wrecked not more than 20 years ago by a disease. Production of sugar dropped to a fourth of what it was, and losses to planters and sugar industries ran into the millions. According to the Department of Agriculture, 'plant breeders began a world-wide search for resistant varieties and instituted a program of selection and breeding. Results have exceeded expectations. After being forsaken as a business risk by almost all financing institutions, the sugar industry in the South has been restored . . .' Yields of sugar are higher than ever before,

and on 250,000 to 300,000 acres in the South we grow sugar cane safely and profitably to produce over 300,000 tons of refined sugar each year.

Nearly all our commercial sugar cane is grown in Louisiana, Florida, and Texas, with Louisiana producing most. A patch of sugar cane is a common sight, however, in many parts of the Southeast, where most farmers make up molasses in the little cane mills powered by a mule (Plate 15). 'Black strap' they call the product, and to many from the South, molasses is prized as much as maple syrup is in New England.

The cane is cut in late fall, as low to the ground as possible, the leaves are trimmed off, and the tops taken off. The whole job is ordinarily done with heavy knives, since machines have not been particularly successful. The canes are taken away to the mill, torn, crushed, and the juice pressed out of them by rollers. After purification, the liquid is concentrated and the sugar crystals taken out by centrifuging, as in the sugar-beet process. The crushed cane after the juice is pressed out is called bagasse and is used for making paper or wallboard. The molasses left after the sugar crystals are taken out is used for cooking. The poorer the process of sugar extraction, the better the molasses, for less sugar is taken out. Low-grade molasses may be mixed with the bagasse to make a valuable cattle feed known as molascuit.

In the Deep South the sugar cane plants usually get through the winter safely and sprout again in spring, at least for several years. Sooner or later, however, the cane has to be replanted even in the warmest places, and in more northern localities it must be replanted every year. In this country most of the cane is cut before it has a chance to produce its silky plume of seeds—and anyway the seed is rather unreliable. Instead of seed, pieces of cane are planted, and from these come the new plants.

The total sugar content nowadays in the canes runs between 12

and 16 per cent—plenty sweet enough to make sucking the cut ends of cane a worthwhile pastime. In the crossroads stores of the South, in the fall, look for the pieces of sugar cane sold for just that purpose.

## Maple Sugar

We have to thank the Indians for maple sugar. Early colonists found the natives of northeastern North America getting maple syrup and sugar from the sap of maple trees very early in our history. The Indians cut the bark, conducted the sap through reeds to containers, and boiled it down by dropping hot stones into the collected sap.

The method we use now is very similar, although considerably more efficient. We bore holes into the bole of the tree, insert 'spiles'—wooden tubes—collect the sap in pails, and boil it down by very efficient evaporators—commercially, that is. On northeastern farms, the sap is still boiled in kettles or large shallow pans. When the syrup is boiled till it becomes waxy, it is poured into molds to crystallize. 'Sugaring-off,' folks call this process.

We tap about 10 million trees a year in the United States in the maple-sugar groves from Wisconsin to Maine and Maryland (Plate 52). A good grove, which farmers call a 'sugar bush,' contains about 70 trees per acre, so that it might be calculated that we use upwards of a million acres for maple-sugar production. This figure is probably too high, however, since most groves have more than 70 trees per acre.

We used to make a great deal more maple sugar than we do now. About 75 years ago was the heyday for maple-sugar production. Cane sugar began to undersell it, the product began to be adulterated in a wholesale manner, and the maple-sugar industry fell off. With better methods of handling the product as well as greater care in handling the sugar bush, the demand for the purer product is increasing.

## Other Sugar

In view of the fact that all green plants manufacture sugar as part of their way of life, it is not surprising that there are a very great many sources of sugar besides cane, beets, and maple trees. There are also various kinds of sugars, some rather complex chemically, and some relatively simple in their makeup. The sugar from cane and beets is technically known as sucrose, and in the course of digesting it your system changes it to the simpler sugar glucose.

You may have been led to believe by misguided campaigns that glucose is a low-grade substitute for sucrose, but you are wrong if you think so. Glucose is a real sugar that can stand on its own, and it is easier to digest than sucrose. What we are getting at is that glucose is manufactured from cornstarch to the tune of some 450 million pounds a year. And this entitles corn to a place among the sugar-producing plants of this country.

## VII

# THE LAND'S ORCHARDS

How it came about that man first began growing his own fruit and nut trees in orchards is still a matter of reasonable doubt. Nobody really knows, yet there are a good many things that point toward the way it might have happened. Savages around the world are accustomed to eating wild fruits or nuts, and generally speaking, they are rather smart about leaving the less toothsome kinds, to say nothing of the poisonous ones, pretty much alone. Primitive peoples who lead settled lives usually know where the nearest and best groves of wild fruits are located. One supposes that sooner or later the idea of bringing seeds of the best fruits nearer home must have popped into the head of a smarter savage; or, it could have happened that the village was moved near the grove, the poorer trees cut out—and the business of orcharding began.

Whether this theory is correct or not may never be known, but an interesting sidelight on it has appeared recently in a publication by the Russian scientist Vavilov. Just south of the Caucasus Mountains in Armenia and Georgia, various kinds of fruits grow wild. Here, says Vavilov, one may see how the farmer, while clearing away forests to make room for grain, has left to grow in his field the better specimens of wild apple, pear, and black cherry trees. And here, he points out, one may still observe all the phases in the evolution of fruit-growing—from forests of wild fruit trees to transitional methods including the grafting of better wild varieties on less valuable wild fruit trees. The first orchards must have been developed in this region, declares the scientist, and perhaps he is right.

## Temperate Fruits

At the present time there are about a quarter of a billion fruit trees in American orchards, and although there are no exact figures available, all these trees together occupy about 5 million acres of land. A great belt of orchard land lies along our coasts—east, west, south, and about the Great Lakes—but there are a great many orchards in the Mississippi River basin, in the foothills of the Appalachians, and in protected valleys of the Rockies. But to be specific, let us consider the various kinds of orchards likely to be seen on American land:

*Apples* (Flowers clustered, *pink and white*). To become really valuable in the United States, apples had to go wild. Apple seeds brought from Europe were planted far and wide as settlement proceeded; missionaries carried them, so did traders and settlers, and Indians took them far into the wilderness ahead of the frontier. John Chapman, better known as Johnny Appleseed, spent a lifetime planting apples in the Ohio-Indiana country early in the nineteenth century. Animals carried the apples about, leaving the seeds to sprout as they would.

How many seedlings died before they fruited, were eaten, trampled, or broken over by livestock, or 'brushed-out' by farmers, no one knows. But here and there chance wild seedlings managed to grow to bearing size. Most of them bore sour, hard, runty apples; a few, a very few, were good. Wherever an observant farmer or a horticulturist, or perhaps a school boy happened along to find a really fine apple, the better seedlings were preserved. Many were not, but some were increased, brought into cultivation once more, and given names. So came our apples, from Winesap and Wealthy to Rambo, and Gravenstein, Ben Davis, Delicious, Grime's Golden, McIntosh, Northern Spy, and many, many others.

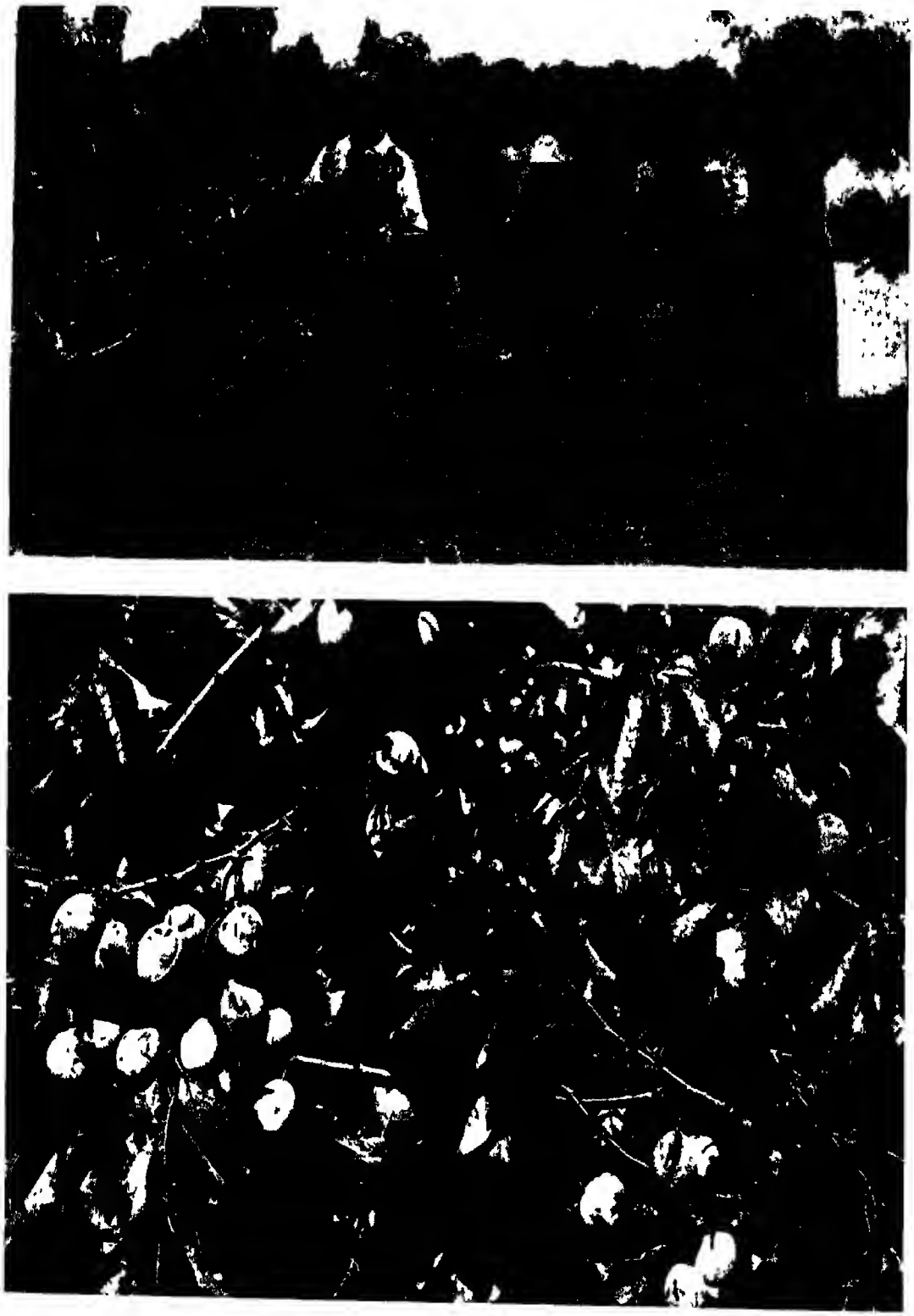

PLATE 17. A peach orchard in the southern Piedmont. The trees are young, but peaches are small trees.

BOTTOM. The fruiting branches of a plum tree in Oregon. Deep blue with a waxy bloom, these plums are the type used for making prunes.

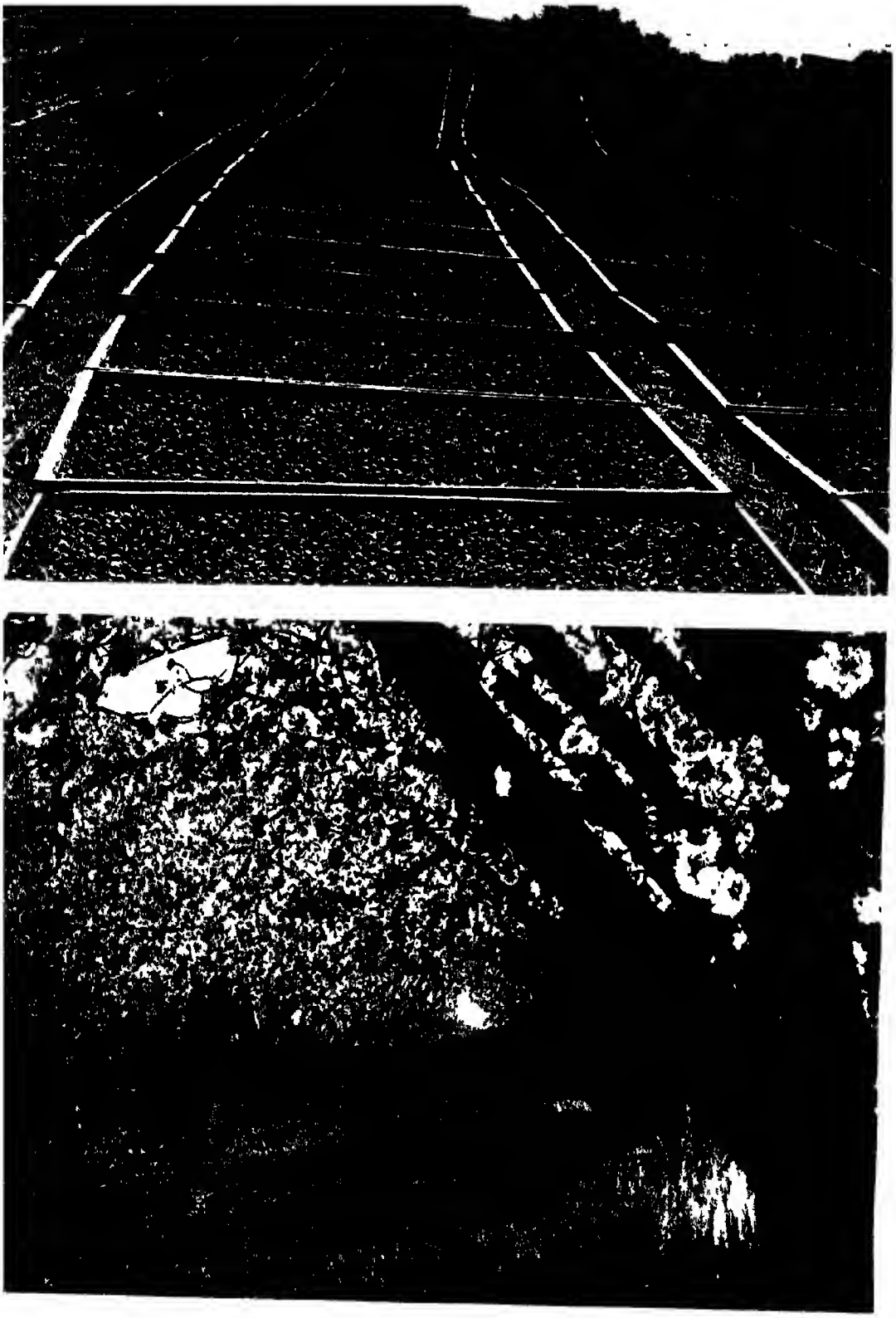

PLATE 18. Prunes drying in the sun in the Sacramento Valley of California.
BOTTOM. A cherry orchard in bloom. The shining dark red bark of cherry trees distinguishes them from other orchard trees.

To be sure, experiment stations in a dozen States have taken up the task of developing better apple varieties, but the bulk of what they have done is based on the original wild apples that were 'discovered' among the chance seedlings started when this country was beginning.

About 71 million trees we grow now, to produce on the order of 150 million bushels of apples. We grew three times that many in 1910 to produce not three times as many apples, but about the same size crop. More care, better trees, increasingly better ways of orcharding, and a third the land now produces crops of the same size as before.

No other fruit tree is so widely spread as the apple, nor is any other so valuable a crop (Plate 16). About the Great Lakes, in southern New England, down the Appalachians in the valleys of the Shenandoah and the Cumberland, on the peninsulas of New Jersey and of Delaware and Maryland, down the Ohio and up the Mississippi and Missouri Rivers, and in the Ozarks and on much of the land in between, are apple orchards to be found. So too are they in the high valleys of the Rockies, the famous valleys of the Hood, Willamette, and Okanagan Rivers of the Northwest, and in California west of the snowy Sierras.

All told, most apples are grown in the East and West, with very few or none in the Plains. Surprisingly, there are no satisfactory varieties for the South, anywhere within 150 miles of the Gulf of Mexico, and no apples are grown in the tropics. Principally within a belt bounded on the North by freezing weather, and on the South by weather cold enough to break the dormancy of the buds, do we grow the apples we need.

An old crop, the apples, known to Swiss Lake Dwellers, and cultivated for some 3,000 years. Originally from the Caucasus region between the Black and Caspian Seas, the apple was grown by the

Romans, who knew perhaps two dozen kinds. The world today has 6,500 varieties.

*Pears* (Flowers clustered, *white*). Although the pears had the same opportunities, so to speak, as the apples, something about our climate or soils proved unsuitable for them so that they never did go wild (Plate 16). Pears came in with the early settlers, and until the middle of the last century all we had were direct importations from the Old World, where choicer varieties have been developed from the original wild pears of the Caucasus region.

Things went swimmingly with pear orcharding for a time. Early catalogues list many fine varieties, and it began to look as though pears were well established. In the meantime, however, something began to go wrong with an occasional pear tree. Nobody knew what the source of the trouble was, but here and there certain trees got sick all over. They were left by the disease looking as though they had been through a fire. People called it fire blight.

About the time of the American Revolution, fire blight became really severe. Pears went down before the scourge as though searing hot winds had blown through the orchards, and the promising development of the pear industry in the East was halted—almost. Since that time the growing of European pears in the eastern United States has been confined to narrow strips on the southern and eastern shores of Lake Michigan, Erie, and Ontario. There the cool summers and mild winters enable the pears to be grown on a large scale, largely without the blight. Not until a hundred years later was it discovered that the disease results from the activity of a little bacillus that attacks the bark tissues. But to this day, no one knows for sure whether the bacillus came from Europe or lay in wait here for the European trees.

On the West Coast, the European pears were brought in by the Mission Fathers to California, and there they throve. North, in the

moderately warm dry valleys of Oregon and Washington, they also did well. Climatic conditions there are not to the liking of the fire-blight bacillus, and with a little careful surgery trees can be kept free of infected branches. Most of the European pears do quite well in the West, and nowadays most of our pears come from the three Pacific States. Most of these, incidentally, are the soft, mellow Bartletts.

For the rest of the country, pear-growing depends upon hybrids between the European pear and the oriental, or sand pear. Thanks to their oriental parent, the hybrids are fairly resistant to fire blight. The sand pears themselves are pretty coarse-fleshed and gritty, and these characters have been passed on, to some extent, to the hybrids, which so far, are inferior to the 'buttery' Bartletts. Even so, the hybrids are pears, and from them it may be possible, plant-breeders hope, to get types altogether resistant to fire blight and with first-class fruit.

Fourteen million pear trees there are now, in the orchards of the country, fewer by nearly ten million than there were thirty years ago. But for all the reduction, the crop is about as large as ever.

Quinces (Flowers white, tinged with pink, scattered). The bushy little quince trees with their many crooked branches are not much changed from their ancestors, which still grow wild in Persia and Turkestan. And one after another the trees are disappearing. Nearly 2 million there were in 1910, but the last census—1940—shows, alas, only 130,000 left. These are to be found principally in New York, Pennsylvania, and Ohio, and a few on the Pacific Coast.

The fruit is yellow-fleshed and scarcely tasty; the tree takes fire blight as bad as a Bartlett pear. The demand for the fruit is not great, nor are quinces well known. A pity too, because in all the world there is no better spread for bread than the old-fashioned 'quince honey.'

*Peaches* (Flowers strewn along the branches, *shell pink*). Of all the orchards in full bloom, certainly a peach orchard is the most beautiful. Spread across the hills in early spring, the soft glowing pink of the blossoms is a sight beyond description. Sometimes the blooms come too early, there is a heavy late frost—and there is no peach crop that year.

Early writers thought peaches came originally from Persia, but there now seems no doubt that they came from China, where they were known and used at least 3,000 years ago. By way of Persia the fruit got to Europe, and from there to the United States. Here we grow peaches now in nearly every State, but the really extensive orchards increase as the climate gets milder and warmer (Plate 17). In the South, in California, about the Great Lakes, along the central Atlantic coast, and in protected valleys in many States, peach orchards are fairly common.

The peaches occupy much land—as much as it takes for 70 million little trees. From the great orchards we harvest between 50 and 60 million bushels of fruit ordinarily, although once, in 1931, we produced 70 million. Because the peaches are perishable, we dry or can a good proportion of the fruit we grow, but some years, even so, when the crop ripens all at once over large areas, peaches may be thrown away by the carload.

There are several thousand varieties, but only a few get to the markets—Elbertas, Georgia Belles, Hales, and perhaps half a dozen others. Some have flesh that clings to the seed, some have flesh that comes free. Clings and freestones the growers call them, and much debate there is over which is the better type. Then there is the 'fuzzless' peach, better known as the nectarine, but a peach for all that. This type is grown principally west of the Rockies and unless you see the fruit, you will not be able to tell a nectarine tree from a peach tree. And as with other peaches, there are freestone and clingstone varieties.

*Plums* (Flowers thickly scattered along the branches, *snow white*). What we lump under the one name of plum becomes several different kinds of plants when they are sorted out. First of all there are the European plums originally from the Caucasus region that were brought by the early settlers to the New World (Plate 17). Secondly, there are the damson plums, also from Eurasia, that are delicious but less frequently planted than the European plums. Thirdly, there are the American plums that have been developed from our own native species here in the United States. Fourthly, there are the Japanese plums that were brought into California at the end of the last century. We could go on to name a number of other species (not horticultural varieties), but they are of lesser, local, and in some cases, untested significance.

The European plums did pretty well—do yet—in New England. They didn't do at all south of Virginia. They did well around the Great Lakes; and they grow very well indeed in the Intermountain region and the West Coast States. In a way it seemed as though the farther they got from Europe, the better they grew. But they never were able to make the grade in the enormous areas of the south central and southwestern United States. Even so, they are the most important commercially of all our plums. California has some 200,000 acres of them, for example. And it is from the European plums of higher sugar content that we get prunes—plums that can be dried without taking out the pit (Plate 18).

The damson plums are made of sterner stuff; they will grow and thrive under much more rigorous conditions than the European plum. They are little trees, their fruits are small and tart—and delicious in preserves and jams. Growers say, when you have no time to take care of your plums, grow damsons.

The Japanese plums are rapidly assuming importance. They have less trouble with plum diseases, although they bloom early and the flowers are often killed by frosts. The big soft plums with red flesh

that you buy in the market are of this type, and very fine eating they are.

In the South and Central United States it is the native American plums that take the lead. Their fruits do not compare in size with the European plums, but they can stand climatic extremes far beyond those any other plum can put up with, and they are delicious to eat. Because they are accustomed to American diseases and insect pests, they are relatively free of these—in marked contrast to the species from overseas.

Adding them all together we are growing nearly 25 million plum trees now, with heaviest production and most trees along the West Coast. This number is considerably less than we used to grow, but the annual crop amounts to some 25 million bushels even so.

*Cherries* (Flowers *white*, clothing the branches). Sweet and sour cherries, both originally from the Caucasian region, are fairly well distributed over the country. Cherry orchards are concentrated in the three Pacific States, in intermountain valleys in the Rockies, and about the borders of the Great Lakes (Plate 18).

Sweet cherries are used for fresh desserts and we grow them principally in the West. Sour cherries—mostly from the Great Lakes region—are the great source of the American public for cherry pies—and how vitally important this is requires no elaboration. Twelve million cherry trees we grow in American orchards and three hundred million pounds of cherries we get from them.

In the South, the Southwest, and the Northern Plains, cherries do not do particularly well, and few are to be seen in these regions. Cherries will not fruit where the air is dry. In the Plains region, however, the little Bessey cherry, native to that part of the United States, has been improved and is planted to some extent. It is a gray-leaved bush up to four or five feet in height that bears white flowers and blue-black fruits.

*Apricots* (Flowers *white*, scattered along the branches). Last of

the stone fruits in commercial importance, but prized by many as the most delectable of all of them, is the apricot. Perhaps 5,000 years ago the Chinese knew and grew this fruit, and by way of Armenia, Greece, Italy, and other countries in Europe it finally arrived in Virginia and California early in the eighteenth century.

By this time we grow some 6 million apricot trees, nearly all of them in California, although a few orchards may be seen in Oregon, Washington, Arizona, and New York. If the apricots bloomed a little later (they flower a good week ahead of most peach trees) we could grow them in other parts of the country. As it is, they appear on the eastern markets for only a short time as fresh fruit, and the rest of the year we must be content with dried or canned apricots, which is the way most people know them.

## Subtropical Fruits

Subtropical conditions in this country are limited to the southernmost fringe of our territory. Southern California comes readily to mind, as does Florida; less well known perhaps are the southern portions of the States in between these two, notably Arizona, Texas, and Louisiana.

A rather surprising variety of subtropical or tropical fruits can be grown in this portion of the United States. Avocados, figs, olives, dates, and citrus fruits, such as oranges, lemons, limes, and grapefruits, are grown in really large enough quantities to be important. There are many others that may reach the fruit markets but that, in the aggregate, occupy relatively little land. Among these are bananas, guavas, mangoes, papayas, Oriental persimmons, pineapples, pomegranates, and lesser numbers of jujubes, loquats, sapodillas, sugar apples, cherimoyas, and a number of others. It is possible that one of these days any or all of these lesser fruits may become important.

*Avocadoes.* Avocadoes are so rapidly coming into favor as a

vegetable that it may seem out of place to treat them as a fruit even though that is what they really are. In the markets you buy them as alligator pears, avocados, or calavos. They look like big varnish-green pears and have a seed the size of a golf ball (Plate 19).

We grow nearly a million avocado trees in California or Florida, and the chances are good that this number will increase, since the American public is beginning to take quite a liking to the fruit in salads. The trees are evergreen and have shining, luxuriant foliage that impresses most travelers as 'tropical looking.' Originally avocadoes came from Central America.

*Citrus Fruits.* The types of citrus fruits we grow in commercial quantities, i.e. that occupy appreciable amounts of American land, are oranges, grapefruits, lemons, and limes. To the layman, any one of these trees looks about the same as the others unless the fruits are present. All of them have shining dark-green leaves that persist the year round, and all of them are little, round-topped trees 10 to 20 feet tall. We use the most land for our 41 million orange trees, less for 11 million grapefruit trees, and still less for the 6 million lemons and half a million limes.

Besides these types of citrus, we grow a number of others in lesser quantity. For example we have a few thousand trees of the citron—from which candied citron is made. The fruit looks very much like a large lemon. We also grow about 17,000 kumquats, which are small evergreen shrubs that produce little orange-colored fruits much the size and shape of large olives. They are used for preserves or to eat raw, and are spicy, fairly juicy morsels. We grow fair numbers of tangerines and of the satsuma oranges, which resemble them. The calamondins, or Panama oranges, look much like tangerines; we have but few of these. The rest of the citrus fruits consist of crosses between a number of fruits, such as: limequat (lime + kumquat), tangelo (tangerine + grapefruit, some-

times called pomelo), and so on. Such hybrids as these have been developed in the attempt to get citrus fruits that would be hardier, that is, able to withstand greater cold.

All the kinds of citrus fruits are at home in southeastern Asia—in eastern India, Indo-China, southern China, and the Philippines—and it was there that men first began to cultivate them. Between that time and this there extends a period of some 3,000 years during which these fruit trees finally arrived in the southern fringe of the United States by way of Mediterranean Europe. They were established at St. Augustine, Florida—our oldest city—in 1579, and the Franciscan monks had them at San Diego in 1769. Some kinds even went wild in Florida—as did the orange and lime—but most of them remained respectably in cultivation in the citrus groves both of Florida and California. Gradually these trees began to be grown in southern Louisiana, Mississippi, Georgia, Alabama, and in Arizona and the Rio Grande Valley of Texas, so that at the present time we now have some 60 million citrus trees in this whole territory.

Early in the game the orange business began to flourish luxuriantly in Florida. American growers set out to take the American market away from the producers in the Mediterranean region, who had held undisputed possession of the world's markets for many years. The Florida industry kept on doing better, and after a while was planning to invade the Old World by shipping oranges direct to northern Europe. But Florida's bubble burst in the winter of 1894 and '95, when two terrific freezes nearly wiped the citrus industry off the map. Florida has re-established her citrus groves—a little farther south on the peninsula—and in the meantime California came forward with her citrus industry, rivaling Florida ever since (Plate 19). More recently Texas and Arizona have come into the picture, particularly with grapefruit production.

Groves of citrus trees (people rarely call them orchards) are

always easy to spot because they are deep dark green in color, and the trees are small. The trees usually have fruits on them the year round, which makes it easy to distinguish them, and although there are ways of telling the different citrus fruit trees apart when they have no fruit on them, you will do well to let the growers show you, rather than to read it in a book.

All the commercial citrus trees are easily frozen, which is why they are restricted to the warmer parts of the southern United States. There is one species—the deciduous orange—that will grow in Seattle, Washington, or New York City (but not Chicago) and that is relatively very hardy. Its oranges aren't good to eat, but they are ornamental, and because the plant is so hardy, it is used for breeding, and ordinary oranges are grafted on it. But the ordinary citrus fruits are very susceptible to frost, which is the reason why growers usually have heaters designed to warm up the groves on cold nights. On a frosty night the groves are outlined and interspersed with the bright lights of the oil-burning heaters that are usually, but not always, able to keep the temperature above the danger point.

*Dates.* One of the earliest plants cultivated by man, the date is a palm tree that may get to be 100 feet tall and live for as much as 200 years. It is believed to be a native of India, or perhaps Arabia, and as far as we know it was used 5,000 years ago. The Babylonians grew dates and so did the ancient Egyptians. Because this beautiful tree can grow with so little water, it is an important crop plant for people who live in desert country.

The oldest of the date palms in this country were brought to California by the padres who planted them on the mission grounds. These dates, even though very old, bore little or no fruit and as a result no one bothered to plant dates except for ornament. However, some of these ornamental plants eventually began to bear fruit, and people became interested in experimenting with

date-growing for profit. By now we have about a quarter of a million trees in southern California and Arizona with just a few in southern Texas, and we harvest some 6 million pounds of dates from them (Plate 20). Biggest production in the world, of course, is still in Iraq on the site of ancient Mesopotamia, where there are perhaps 20 million date palms.

Dates contain about 54 per cent sugar and 7 per cent protein and have a very high food value. Just off the tree they are soft and sweet, and as palatable as any fruit you ever ate. Most of the fruits reach us in boxes or pressed masses, and are enough like candy to serve as a very good confection. We will probably grow more dates as time goes on, of better varieties. Altogether there are about a thousand different kinds, of which the Deglet Noor, from the oases of the Sahara, is the one we grow the most at the present time.

*Figs.* Most people think of figs as tropical, but they grow very well on the Atlantic coast from Washington, D.C., south, and on the Pacific coast from Seattle, Washington, to southern California. Actually, commercial fig growing is pretty well confined to the southern States, with greatest production in California (Plate 20). Most places the fig is a bush, but in California the fig trees may reach as much as 80 feet in height.

There are a number of kinds of figs, some of which produce fruits in a perfectly ordinary manner. But there are others that have a rather complex life history. Such a one is the Smyrna fig, which cannot bear fruit unless an exceedingly tiny wasp pollinates its flowers. The wasp has to live a part of its life on another kind of fig, the capri-fig, so that to grow Smyrna figs you must grow both kinds, in addition to the wasp. Californians will tell you that first attempts to raise Smyrna figs were a miserable failure. Even the magnificent climate of that great State had no effect; the figs fell off before they ripened. When capri-figs and the little wasp

were imported, however, and the Smyrna figs properly pollinated, the figs stayed on the trees and ripened as they should have. There is, incidentally, a whole lot more to this process than is written here, and if you are interested, a good book on figs will explain it.

Figs came originally from southern Arabia several thousand years ago, and are grown extensively in the Mediterranean region, where the whole story of the little wasp and its peculiar history has been known a long time. In the United States we have now about 3 million fig trees, or bushes, of which nearly 2 million are found in California. Texas is next, with about a third of a million, and the States of the Deep South have most of the rest. We used to grow half again as many as we do now, but fig production has dropped off markedly in the past 10 years.

*Olives.* If you have ever tried to eat an olive right off the tree, you know why olives must be soaked in lye solution before they are ready for eating. The olives are shining purplish black when they are ripe, and they certainly look good enough to eat, but the bitterness has to come out first, which is what the lye is for. It also softens them, and after the fruits have been pickled in brine, they make the finished product we are accustomed to eating.

Spain, Italy, and Greece are the principal places where olives come from, but we have about a million and a quarter trees on some 25,000 acres of land in the Southwest. Most of these are in California, but there are a few thousand in Arizona. The orchards (groves, most call them) are easy to detect because, like no other orchard trees, olive trees have a soft gray foliage that is distinctive (Plate 21). The leaves are evergreen and willowlike in shape. The fruits are picked in October.

The olive is a very old fruit, having been grown since prehistoric time. Olives were brought into California by the mission fathers, but they did not become really popular there until 1885. After that they were planted in great numbers, and in 1919 California had

2 million trees. The popularity of the olive waned somewhat, as figures in the preceding paragraph show, but it is certain that this crop will remain one of importance in this country.

We extract olive oil from the ripe, black olives to the tune of some 400,000 gallons a year. The purple to black fruits go to make pickled ripe olives, and the green fruits to make pickled green olives, with pits intact or stuffed with pimientos, almonds, or other things. Even from the older, gnarled trees first planted in the grounds of the California missions, we still harvest bountiful crops of a fruit unique in America.

## Nut Orchards

Six different kinds of nuts are grown in the United States in quantities of commercial importance. This excludes peanuts, which are not nuts at all (see p. 134), and coconuts, which are grown, but scarcely in quantities of importance. Growing nut trees is decidedly on the increase in this country, especially as nuts become staples rather than luxuries. Nut tree groves or orchards are most commonly seen in the South and along the Pacific Coast.

*Almonds.* You may have noticed the similarity between the pit of a peach and an almond with its shell intact. Almond trees and peach trees themselves look very much alike; in fact, almonds and peaches are very closely related, so closely that there are botanists who think the peach is merely an offshoot of the almond. An almond on the tree looks for all the world like a peach, although it is likely to be rather hard and does not acquire the plump roundness peaches do. What would correspond to the fleshy part of a peach is, in the almond, a tough rind. With the rind off and the shell broken, the almond seed appears. The seeds are usually salted, or made into almond paste, or used to prepare almond extract.

If we could only get almonds that would not bloom so early, we

could grow them in many other parts of the country, perhaps as we now grow the flowering almonds that do not bear fruit. But since almond flowers cannot stand late frosts, we grow nearly all our almonds in California. We use about 80,000 acres for them and we have another 20,000 acres in young trees that are not yet bearing. This land supports about 5½ million trees. Our almond acreage is increasing, and so is our production—we used to import more than we raised, but now we raise more than we import.

As we noted earlier, almonds came originally from the eastern end of the Mediterranean. Early horticulturists tried to grow them in the East, but without success. The growing of almonds in California has developed during the past 50 or 60 years, and except for some kinds grown in Spain, the best almonds on the world's markets now come from that State.

Chestnuts. One of the greatest tragedies in the history of American forests occurred in the early part of this century. Through the great hardwood forests of the Appalachians swept a fatal fungus disease from the Orient, selecting for its host the magnificent American chestnut. Where formerly millions of wild trees shed their chestnuts for the gathering, the species is nearly gone, in its natural range, and on the hills are left standing the bleached gray-white skeletons that in another century will have fallen and gone (Plate 48).

West of the Rockies, where so far the blight has not struck, there are some plantings of American chestnuts and of Chinese and other species that provide a small supply of nuts. For the time being, the growing of chestnuts awaits the plant breeder's successful development of disease-resistant varieties. There is hope, but the breeding of trees is slow, and the future of the chestnut remains uncertain.

*Filberts.* Confined to the Pacific States, largely to Washington and Oregon, are a million and a half filbert trees that produce

almost 5½ million pounds of nuts each year. The commercial production of these nuts is an important industry in the Willamette Valley of Oregon and in near-by parts of Washington. The filberts are of European origin and they have never been able to stand the climate or the diseases by which they are attacked in the East.

The trees are not large, reaching heights of 15 to 25 feet, and developing rather compact crowns. Actually they are well-bred hazelnuts, improved, and greater in size than their wild hazelnut ancestors, but as yet scarcely distinct. They bear long catkins in the spring, from which the pollen blows to fertilize the female flowers, whence come the filberts.

For the past 10 years we have imported fewer and fewer filberts and produced more and more of our own. The numbers are approximately equal by this time, but if filbert-growing continues to spread as it has during the past decade, one of these days not far off, we shall grow all we need.

*Pecans.* In the southeastern quarter of the United States there grows wild a species of hickory tree that is known as the pecan. Almost a hundred years ago a Louisiana slave, by the name of Antoine, selected a superior variety from amongst the wild pecans and grafted it on trees that bore ordinary pecans, by this means eventually obtaining good quantities of better nuts. Others tried the same thing; finer types were searched out and increased; and plant breeders began to hybridize and develop selected varieties. Pecan groves were planted in many parts of the South and the 'papershell' began to appear in quantity in the nut markets.

From the improved varieties we now gather some 20 million pounds of pecans yearly, and from the wild and seedling trees, 40 to 60 million pounds. The nuts contain over 70 per cent fat, a content higher than that of any other vegetable product, according to the experts (Plate 21). They come to us either unshelled or shelled and perhaps salted. Pecan trees to the number of nearly

11 million provide the great nut crop gathered from a native American tree that has made good. Diseases that are causing concern to growers have appeared when the nuts were planted in groves, but breeders will solve this problem just as they have for other crop plants.

Pecan groves in the South are still of two kinds. You are most likely to see the ordered rows of the commercial orchard, each tree with high-lifted branches (Plate 22). But there are many fine groves of native pecans, from which all other kinds of trees have been removed, that produce heavy crops and that are carefully tended by their owners. You will find both kinds in the Deep South, but only the planted groves in the northern part of the pecan range.

*Tung Nuts.* In 1905 the tung tree of China was introduced into the United States largely through the efforts of David Fairchild, who was then in charge of plant introduction for the Department of Agriculture. It was brought in because tung nuts contain a valuable drying oil, much like linseed oil, but more resistant to water and able to dry more rapidly. Ten years ago there were a few hundred thousand tung trees being grown in the Deep South; today there are some 13 million with more being planted all the time.

We grow tung trees from South Carolina to Texas, with greatest numbers in Mississippi, both in trees of bearing age and non-bearing age. The trees grow very fast, often reaching a height of 6 or 8 feet the first season from seed, and they will grow in types of soil unfit for other kinds of agriculture (Plate 22). For all the great boom in tung oil, however, much remains to be done in getting better varieties. In the meantime this country is now harvesting over 2¼ million pounds of the poisonous but oil-bearing nuts, and there is reason to believe that there will be greater expansion of this relatively new and promising industry.

*Walnuts.* While we grow black walnuts in reasonable quantity,

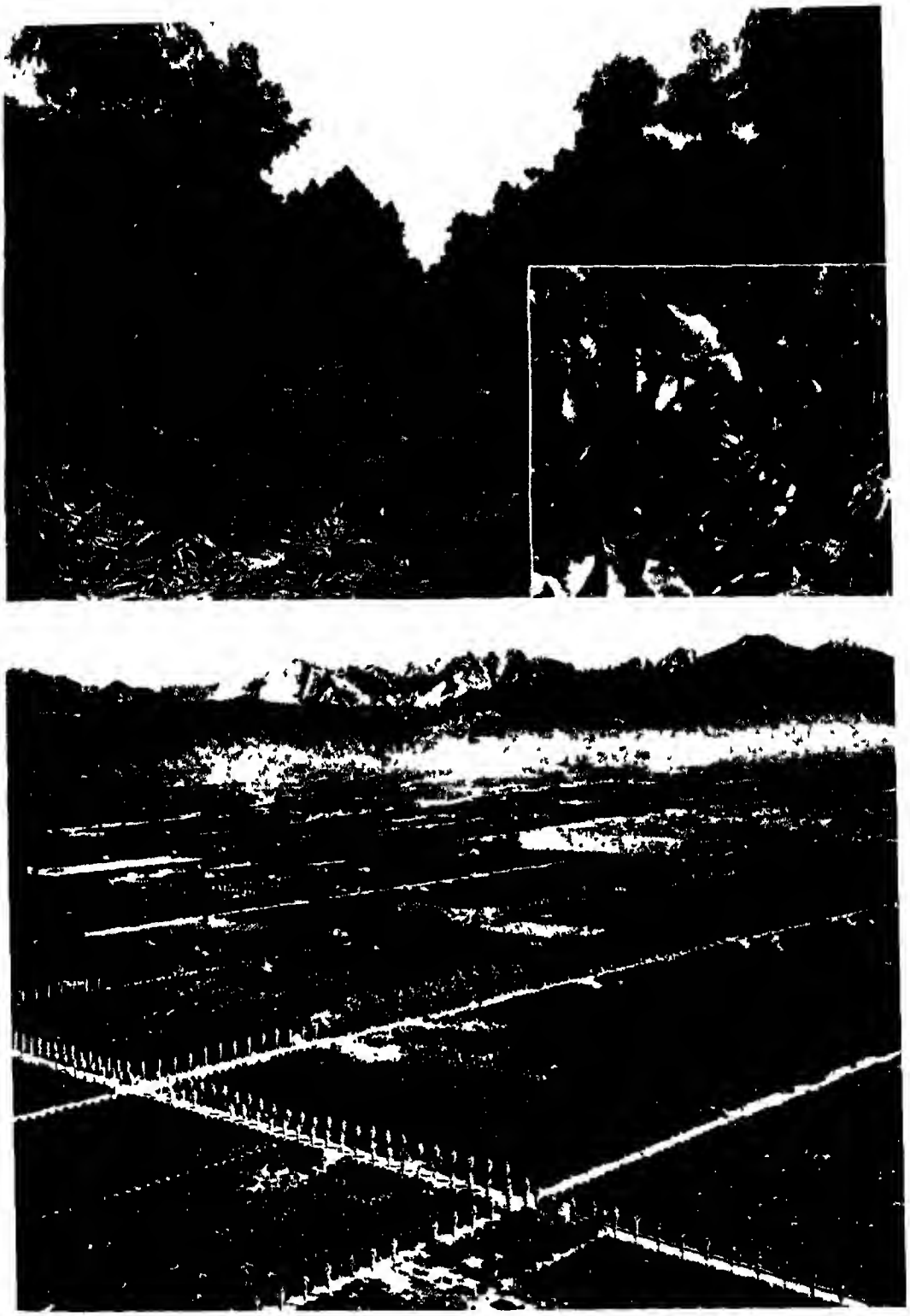

PLATE 19. An avocado orchard. Inset shows the pear-like fruit hanging in the heavy green foliage.

BOTTOM. An airplane photo of orange groves in the Glendora section of California. Palms or eucalyptus trees line the avenues.

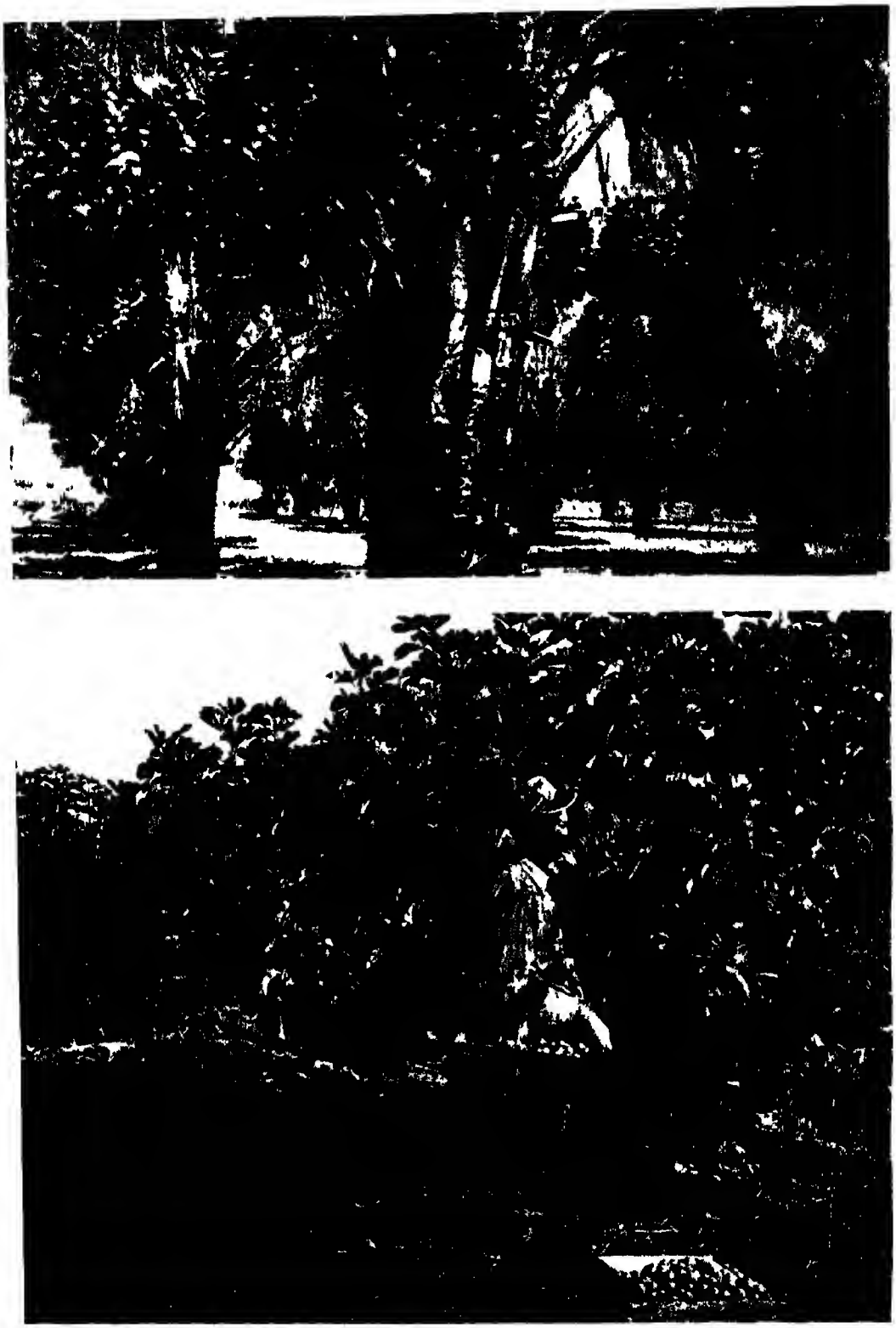

PLATE 20 A date palm grove in Southern California. The dates are about ready for picking BOTTOM. A grove of Kadota figs in California. The trees are about 14 years old, and may eventually become big trees.

PLATE 21. A grove of Sevillano olives at Corning, California. Olives are hanging in the tree on the right.

BOTTOM Two good pecan clusters. The husks must come off, as must those of other hickories, to free the nuts.

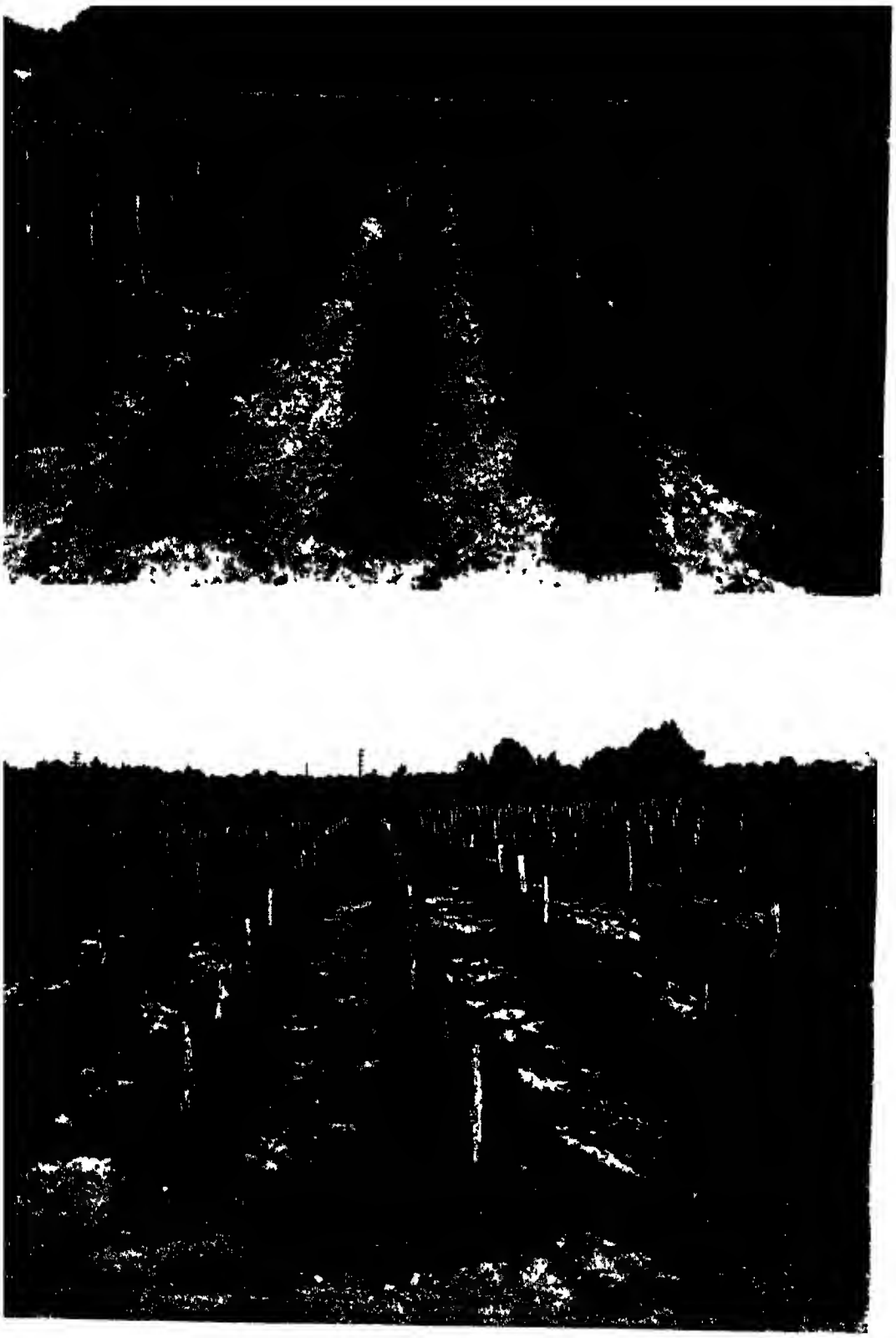

PLATE 24. A typical field of red raspberries on the Pacific Coast.
BOTTOM. A good field of dewberries, here permitted to sprawl.

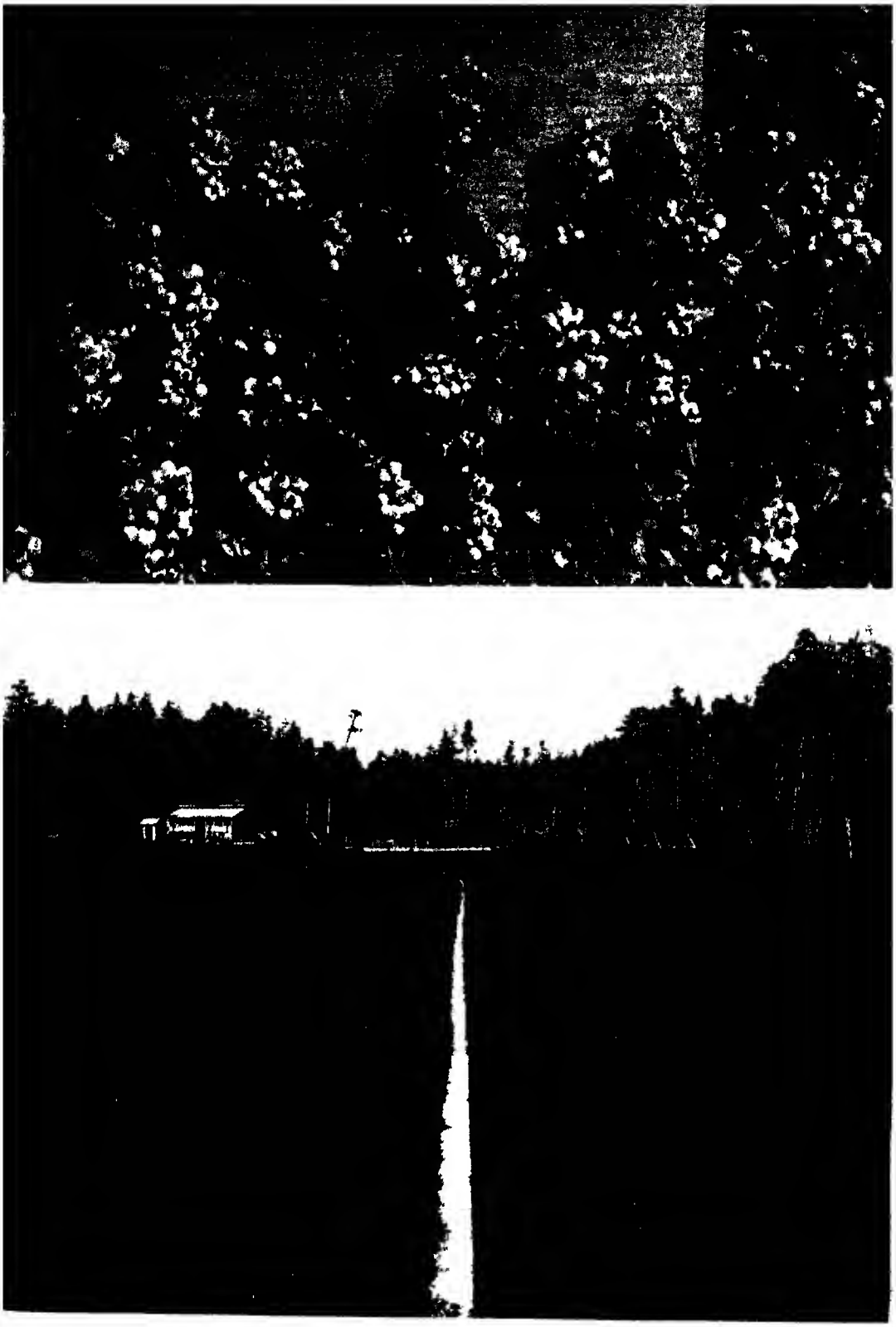

PLATE 25 A close-up of an excellent crop of blueberries in a Maine field.
BOTTOM. An Oregon cranberry bog.

PLATE 28. A field of artichokes. These plants resemble big thistles. The bases of the bracts around the flowers are a delicacy.

BOTTOM Asparagus field in New Mexico; this is what asparagus tips look like when they grow up.

land in English walnuts amounts to approximately 170,000 acres, nearly all of which is in California, Oregon, and Washington. In those western States this tree seems to do its best, but for all that, there are trees of bearing age in at least 43 States. Only in the very coldest does the tree fail; only in the milder States does it fruit abundantly; and only in the West are the nuts of the excellent flavor and quality that are expected when we buy them at the grocery store.

English walnuts came first from Persia, and really ought to be called Persian walnuts. However, early settlers brought them from England and to distinguish between them from the American black walnut, they very naturally called them English. The trees are very beautiful and have the cleanest, most light-colored trunks of any orchard tree (Plate 23). We use the nuts to eat, and the timber is exceedingly valuable. Walnut oil, pressed from the nuts, is used for flavoring and the oil cake for livestock feed.

## VIII

# BERRY PATCH AND VINEYARD

If you were to ask a botanist what a berry is, he would give you a definition that might cause you some trouble. A berry, he would say, is a one-celled, fleshy fruit with seeds scattered through the flesh. Now if you will apply this definition to some of the fruits you know, you will find all sorts of things getting into the berry patch. There would be tomatoes, for example, watermelons and eggplants, and a number of other fruits that you will not find in this chapter. The definition would not include raspberries or blackberries at all, since they, the botanists say, are compound fruits consisting of a series of tiny, one-seeded fruits joined together. Neither would strawberries be called berries, since their seeds are on the outside, not the inside. For the purposes of this chapter, therefore, it appears that to be understood we are going to have to be incorrect, at least to some extent.

By whatever name we call them, however, the little fruits like strawberries, blueberries, currants and gooseberries, cranberries, blackberries, and bright red raspberries are highly valued by everyone. Expressed in terms of money, all of these berries together bring between 45 and 60 million dollars a year to the industry that produces them. They occupy on the order of 350,000 acres of American land, to which, in a manner of speaking, they have every right, since most of them came from America or were developed here.

## Strawberries

The most familiar and valuable of the lot, and occupying more land than all the others together, are the strawberries (Plate 23). They are grown in home gardens and on a commercial scale in every state as well as in Alaska, and they can get along at sea-level or on mountains as much as 12,000 feet above the sea.

There is no doubt that the exquisitely-flavored wild strawberries both of Europe and the Americas must have been avidly eaten and relished long before history began. The story of American strawberries—because all of the berries we get today originated in the New World—really begins, however, in Chile. There it was that the Indians grew patches of the better kinds of wild ones, and it was there also that a strain of strawberries with perfect flowers was introduced into cultivation—and thereby hangs a tale.

The fact is that wild strawberry flowers usually have the sexes on different plants. This may not seem important, but it means that in order to get fruit you must grow two kinds of plants in the same patch, and only the female-flowered plants will bear fruits. Assuming you are interested in berries rather than flowers, it would be much better if you could find a strain of strawberries that had perfect flowers, that is, flowers with male and female parts both present. Well, the Chilean Indians found just such a strain, and although botanists have since hunted over miles of wild patches, they have not located a single perfect-flowered plant. They suspect that Robinson Crusoe's island, Juan Fernandez, off the coast of Chile, may be the best place to look, but until recently at least, the proper survey had not been made.

At any rate, a certain Monsieur Frezier managed to get five of the Chilean plants to Marseilles in 1714. In the meantime wild meadow strawberries of eastern North America had already been taken to the Old World. The North and South American plants

were crossed, in Europe, and from them the modern strawberry was eventually developed. It was not very long before the new types were on their way back to the New World. And by 1800, commercial strawberry-growing near the largest of our cities was going on briskly—with the strawberry that went to Europe, acquired culture, and came home again.

We have a great many varieties now, although the chances are you may never have heard their names. The Klondike occupies most land, the Howard 17 next, and the Aroma, Blakemore, Missionary, and Marshall in the order given. There are 30 varieties that are important, and many others that are grown here and there. The chances are fairly good that eventually people will call for Klondikes or Aromas just as they now ask for named varieties of apples.

It is worth noting that there has been no let-up in breeding work with strawberries. Many private individuals and a goodly number of public agencies are working hard to develop superior sorts. Breeders are fairly certain that there are many desirable characters in the wild forms that have not been brought in to enhance our present types. They are trying the wild strawberry of the Rocky Mountains, for example, and as many strains of the Chilean type as they can lay their hands on. Judging from the amount of work going on, bigger and better strawberries are on the way.

## Blackberries

Back in the days when there were very few white people in America, wild blackberries were nowhere near as abundant as they are now. They throve demurely on the edges of little clearings, and did well in burned areas resulting from fires set by lightning or Indians. But as settlers cleared ground, wild blackberries really came into their own. They spread out into the clearings and increased and multiplied at a great rate. Carried by birds from place

to place, and pollinated back and forth by pasture bees and other insects, the species of blackberries were mixed so generally that the results still baffle the experts. Immense numbers of hybrids were developed in this gigantic, though unintended breeding project, and from them we have selected the best to grow for market.

Besides these American types we grow the Evergreen blackberry from England, and the Himalaya variety from Europe. Both these berries have gone wild in Oregon and Washington, and both of them supply market material. But by far the most of our blackberries originated from the wild plants of America, and between 30,000 and 40,000 acres of land are now used for the crop, which is grown in every State in the Union.

Some of the types are trailing, and must be grown on trellises or allowed to spread out on the ground (Plate 24). Others are erect and able to support themselves, just as raspberries are. The erect plants are usually called blackberries, and the trailing ones, dewberries. It was from seedlings of a very rank-growing, trailing blackberry at Santa Cruz, California, that Judge Logan grew a red-fruited blackberry later named the Loganberry. He assumed it to have been a cross between a blackberry and a raspberry, but later studies indicate it is probably a red-fruited sport of the wild black-fruited berry. The Youngberry is also a dewberry that originated from a cross between Luther Burbank's Phenomenal (which resembles a Loganberry), and a dewberry of the East. Very similar to it is the Boysenberry, also a dewberry, but of unknown parentage.

## Raspberries

Raspberries are so closely related to blackberries, that we ought really to have considered them together. Yet there is a clear difference in the way the berry comes off its stem. Raspberries come clean, leaving the little white core on the bush. Blackberries come

off with the core to which the fleshy little globes are firmly attached.

Commercial raspberries have been developed from the wild red raspberry of Europe and the red and black wild raspberries of North America. Over 400 years ago Europeans were cultivating the red types, and the American red berries were being grown in this country by 1800. There has since been a great deal of hybridizing of these two, as well as of our wild black raspberries, to produce the plants we grow now. Most of the raspberries we see in the markets are red or black or purple. The purple ones come from crosses between the red and black fruits. It is interesting to notice, however, that raspberries come in nearly every color, including yellow, amber, pink, red, lavender, purple, deep wine, and black.

Some 60,000 acres are used for raspberries in the United States, and nearly all the States have at least some land in this crop. In the West, Oregon and Washington lead the field, and in the East, Minnesota, Michigan, New York, Ohio, and Pennsylvania. Universally the bushes are set in rows, often with wire trellises to keep them erect (Plate 24). Ordinarily raspberries are erect bushes 4 to 5 feet high, but the breeders have produced types 15 feet high, nearly 30 feet across, and with stems up to 3 inches in diameter. Of these tasty fruits, as well as of the strawberries, new and better kinds are on the way in the many breeding centers of the country.

## Blueberries

Each year duly grateful berry-pickers gather to harvest the crop of blueberries or huckleberries so freely produced in the wild. Some of the patches are in the high mountains, some are deep in northern bogs, and many are in woodland burns. But wherever they are found, these sharp-tasting, excellently flavored little berries grow on acid soil. The blueberries are related to heather, rhododendron, mountain-laurel and many other heath-like plants, all

of which also require acid soil to do well. And while this seems a simple thing, it was not until 30 years ago that people realized that if they wished to grow blueberries, they would have to have acid soil to do the job. Once that fact was understood, however, the way was open for blueberry culture.

From the beginning of work in 1909, American blueberries in cultivation were bred for better flavor, greater size, and heavier yields than are to be found in the wild plants. Astonishing success has rewarded the efforts of the plant breeders. Berries over an inch in diameter and 20 or more to a cluster have been produced, and are gradually finding their way into commercial production. Associated with much of the remarkable work done is the name of the late Dr. Frederick V. Coville of the United States Department of Agriculture. This scientist spent many years at work on blueberries and to him goes much of the credit for the improved types we have now. A few weeks before he died, Dr. Coville terminated 49 years of botanical research with a scientific paper on blueberries at the end of which he named the last of the excellent berries he had developed. Inch-thick fruits with delicious flavor characterized the bush—of which, at that time (1937), there was only one in existence. In conformity with the custom of scientists of long ago he affixed a Latin word to the end of his paper that meant 'I am through.' The word was *dixi*, and the Dixi blueberry remains as the great scientist's final achievement.

Nearly all the blueberries we grow commercially are found in the East (Plate 25). New Jersey and Maine have the greatest acreage of cultivated species. Michigan and a number of States in New England systematically harvest the product of the largest wild acreage. All the land devoted either to cultivated berries or to wild ones that are carefully treated amounts to some 31,000 acres. And from these come a million dollar crop.

## Cranberries

A glance at the figures on cranberries in crop reports reveals a rather remarkable stability about this spicy fruit. Of all the crops grown on American land, the acreage devoted to cranberries has varied the least. From one year to another there are differences of only a few hundred acres, and for several years in a row there may be no change at all. Cranberry land reached 27,000 acres in 1923 and step by step it arrived at 950 acres more by 1940, when last figures are available.

The reason is not far to seek. This miniature trailing vine must be grown in a cool, sandy bog to be successful, and the right kind of land is not easy to find (Plate 25). The bog must be flooded, oftentimes very quickly, to prevent freezing, and there must be good drainage ditches to get the water off again equally quickly. New sand, perhaps an inch deep, has to be put on every other year or so. The water table must be kept at just the right level. All these things make cranberry-growing a specialized and expensive business—and in view of this, we need not be surprised to find that the land devoted to it does not fluctuate in area.

We began growing cranberries about 1840, and our crop is now worth 6 or 7 million dollars. The berry is an American plant found wild in the bogs of the northern part of the United States. Massachusetts grows the most, New Jersey is next, and Wisconsin, Washington, and Oregon follow. There are a few commercial bogs in other States, but the five mentioned produce by far the largest part of the crop.

## Currants and Gooseberries

Years ago we grew far more currants and gooseberries than we do now. Botanists discovered that blister-rust, a serious disease of the white pine, depended on currants and gooseberries for its

spread. And since white pine is a very valuable timber tree, the berrybushes were eradicated over large areas, and as a consequence interest in these small fruits lagged.

Currants and gooseberries, although they are rather commonly grown in family gardens, are not a particularly important crop either in terms of land or dollars compared to other fruits. On the order of 3,000 acres are devoted to these bushes, and the crop is worth a little under a half million dollars. New York, Ohio, and Illinois lead in land devoted to currants, and Oregon, Washington, and Michigan lead in gooseberries.

Currants as well as gooseberries came originally from Eurasia, are closely related, and seem both to have come into cultivation, sometime prior to the year 1600, in Europe. The currants we grow here are principally varieties that were developed by American breeders. Gooseberries from Europe were in a fair way to go down before American diseases and conditions in the beginning of their use in this country. By crossing them with American wild gooseberries, however, varieties better adapted to our conditions were developed, and the industry saved (Plate 26).

## Vineyards

The first settlers in America were convinced early in the game that wine growing in the new land was going to be a profitable business. After all, wild grapes were to be found in abundance everywhere; what more natural than to argue that the climate and soil were ideal for raising grapes? Besides, land was cheap. All that was lacking were the proper grapes to grow, because, of course, no one would think of using the wild grapes for the manufacturing of fine wines.

Well, according to the record, the London Company caused a store of 'vine plants' to be brought to Virginia in 1621. The cuttings were planted at Christmas time, but before the spring was

over, the colonists were massacred by Indians, and nothing appears to have come from the enterprise. Not long afterwards, however, Governor Winthrop of Massachusetts started a vineyard on one of the islands in Boston Harbor, but nothing came from his experiment either. One Ambrose Gibbons settled in southern Maine for the purpose of cultivating grapes, fishing, and trading with the natives. The fishing was good, and so was the trading, but the grapes died, even though the wild ones were doing very well on every side. As a matter of fact most of the settlements in New England tried to grow grapes, and every last trial ended the same way—that is, the grapes died.

Southward in South Carolina the Huguenots were trying the same thing and getting the same result. In Georgia, next door, the trustees of the colony brought in wine grapes from Portugal and for a while actually succeeded in getting the grapes to produce. Great plans were made for setting out thousands more, but the grapes died soon after and the attempt was given up. The conclusion was that the laborers who cared for the vines were either unskilled or lazy. Repeated later attempts, however, vindicated the laborers, because the vines failed despite the most expert care.

In the interior part of the country, not far from Lexington, Kentucky, a group of Swiss grape-growers formed 'The Kentucky Vineyard Society,' which started out with great hopes, plenty of cash, excellent stock, and 633 acres of land. For three years the men worked hard and long, treating the vines brought from home with loving care. One vine bore excellent fruit, but it and all the rest took sick soon after, and died, just as others had elsewhere in the new country. The company later moved to a new location in Indiana where the grapes died the same as before.

The long and short of the whole matter is that the growing of wine grapes was tried for 200 years on a considerable scale, and

by experts, and every last vine failed. The grapes froze or they were attacked by a mildew or a black rot or Phylloxera, a well-known root-louse dreaded now by all grape-growers. But in the meantime the wild grapes were getting on fine.

At long last a grapevine appeared in one of the vineyards that kept on producing grapes year after year. The grapes were not particularly good, but at least the vines were alive and healthy. Then another one began to be grown that stayed alive. John Adlum planted this particular grape on the banks of Rock Creek in the District of Columbia. He called it the Tokay the first year he had it, but changed its name to Catawba the following year, and by this name it has been known ever since.

The Catawba did well for John Adlum. It made fine wine and lots of it. People liked the taste of it, and above all it was vigorous and healthy. People began to talk about it, then to grow it themselves, and it was not long before everybody was growing Catawba grapes and remarking, no doubt, how fortunate it was that at least one European grape had made the grade.

But the fact is—now conclusively proved by experts—that the Catawba wasn't a European grape at all. It was a pretty good specimen of an American wild grape that was later traced to a clearing in Buncombe County, North Carolina, whence it had spread from the surrounding woods. Eventually those who once scorned the native vine turned to it for their vineyards. From the wilds of America came the Catawba, the Concord, the far-famed Scuppernong of the South, and dozens of others. On the basis of American grapes is built the entire grape industry of the eastern United States.

In the meantime an entirely different situation was developing on the West Coast. The Mission Fathers, coming into the United States from Mexico, established San Diego Mission in 1769. They brought with them one of the European types of grape, and in

that portion of the country it did well from the start. The Mission grape, folks call it now, and you may see it still in parts of California because it eventually went wild to a limited extent. Along about 1860 grape culture began to accelerate there, and eventually an enormous industry developed in California based altogether on European grapes. It has since spread into other western States, and in terms of value of the product over 90 per cent of our total present-day grape crop comes from the West.

But another circumstance came about early in the development of the new industry, that threatened destruction to the California vineyards. The dread Phylloxera, which had helped to wreck the ventures with European grapes in the East, spread into California, where it had formerly not been found. It spread into France and Italy and other countries as well, and wherever it went, men despaired of saving the vineyards. What this meant in southern Europe where wines are so important can well be imagined. Grape-growers turned to the eastern United States, clamoring for the American vines that were proof against Phylloxera. On the roots of the wild American grapes they grafted the Old World varieties. The root-louse makes no headway with the American vine roots, thus America provided both the cause and the cure. Today the world's grapes are grown for the most part on the Phylloxera-proof roots of the native American grapes.

In the United States the most land in vineyards is located in California and about the Great Lakes, although grapes are grown in every State. On the order of 300 million vines now produce about 4½ billion pounds of grapes. We use them either to eat directly or to make grape juice or wine. In the East the wild grapes are still gathered in great quantity, just as wild blueberries are, and by many are preferred to all others for making jelly. From certain kinds of California grapes, raisins are made by drying the fruits in the sun or in a special drying process. Fertilizers, stock feed,

acetic acid, cream of tartar, and even tannin are also manufactured from grapes. In the East most grapes are trained on trellises, since the American varieties do not ordinarily grow erect (Plate 26). In California many grapes of the European type stand pretty well by themselves and are pruned back each year to the stump (Plate 27).

It is worth noting that breeders hope to make crosses between American and European grapes that will combine the desirable features of both. Such crosses have been made, but while Phylloxera-resistant plants were obtained, the fruit has been poor. Breeders are well aware that the European grapes have a history of some 6,000 years, during which remarkable improvements have been made in the fruits. Combining the excellence of these fruits with the desirable qualities of the American grape, therefore, remains a goal that may one day be reached.

## Hops

Hops, too, are vines, and while they are not as woody as grapevines, still it seems not unreasonable to put them here next to vineyards. They are used to make drinks, as are the grapes, even though there is little similarity between beer and wine.

Nobody knows for sure when hopped beer began to be made. The early European civilizations knew the plant, but Egyptian beer had no hops in it, and the Greeks merely ate the young hop shoots as a salad. The use of hops in brewing seems to have started about the time of Charlemagne, either in Russia or Germany, about A.D. 768.

Hops got into England late in the fifteenth century but both Henry VII and Henry VIII liked their beer without hops. In fact, these kings prohibited their use in England. In Sweden, on the other hand, every farmer was required to grow hops, to the amount of 40 poles of the plant per farm.

In this country we now use a little over 30,000 acres of land for

hops, all of it in Oregon, California, and Washington. The New England States used to grow more hops than the western ones do now, but the industry slowed down, and then was finally nearly wiped out by a disease.

Hops are grown somewhat like pole beans, being trained on poles or pole-and-wire trellises 10 to 20 feet high (Plate 27). In the early fall, the vines are let down and the green, cone-like fruits picked off, dried, baled, and shipped to the brewers. They are used in beer to prevent bacterial action and to give the characteristically bitter taste to that beverage. Hops are also used to some extent in medicines, and there are still some people who insist that sleeping on a pillow stuffed with hops makes for health.

## IX

# VEGETABLE GARDENS ON A GRAND SCALE

WHEN you get right down to it, it is really surprising what a lot of different things people eat. That is one reason why this chapter, for instance, contains such a hodge-podge of material. We use a bewildering variety of vegetables in this country, and added together they make a group that can hardly be much more than listed in a single chapter. Every one of them, as any gardener can testify, has its own particular way of growing, and there is really quite a lot worth knowing about each kind. Yet in terms of American land, potatoes are far more important than spinach, and tomatoes outclass garlic by thousands of acres. For our purposes, therefore, the only safe way to talk about them is to give credit where credit is due.

You can find little gardens almost anywhere in the country, but the really big ones are found most commonly in five rather well-defined regions that are either close to large bodies of water or are in protected valleys. One of the regions is a broad belt along the Atlantic and Gulf coasts from Massachusetts all the way around to Texas. Another is a broad irregular area around the Great Lakes, reaching from New York as far west as Minnesota. A third is the great Rio Grande Valley of Texas. A fourth includes the intermountain valleys of the Rockies, particularly in Idaho, Utah, and Colorado; and the last is along the Pacific Coast and in some intermountain valleys in Arizona as well as the coastal States themselves.

It would be rather difficult to put your finger on the precise

reason why these five areas have become important for producing vegetables while others have not. In fact, there are places outside these regions where big-scale gardens are doing very well. Climate is probably most important; certain kinds of soils are important too, although there is a wide variety of soils in the five regions; and certainly access to markets, good shipping facilities, and other factors all play their part. At any rate, from the roadside, you are likely to see more vegetables within the five major regions than outside them.

There is no particularly close kinship among the vegetables. The things we call vegetables ought properly to be vegetative portions of plants—stems, roots, or leaves. But 'vegetable markets' offer fruits as well—sweet corn, for instance, and tomatoes, and cucumbers—and flowers, such as cauliflower and broccoli. Correctly speaking, the root vegetables, like carrots and sweet potatoes; the leaves, such as lettuce and endive; the stems, such as celery and rhubarb; and the leaf buds, like cabbage—these are true vegetables. But there is no use trying to send people to the flower market for plants such as artichokes, or to the fruit market for beans.

In the listing of vegetables that follows, the plants have been arranged alphabetically because they are easier to find that way. The bigger the acreage they occupy along the roadside, and the more important they are, the longer the treatment. It has been easier to treat a few that are closely related under one section, so that if you are looking for any particular one, you may have to use the index.

### Artichoke

Essentially the globe artichoke is a big thistle, but it is by no means as tough as ordinary thistles usually are (Plate 28). It is grown commercially only in a narrow strip of land along the southern California coast, and it is probably the most exacting of all

PLATE 29 LEFT. Chard, ancestor of sugar beets, mangel wurzels and table beets, and a vegetable in its own right.

RIGHT. Wild cabbage, ancestor of kale, collards, cabbage, cauliflower, Brussels sprouts, and ordinary cabbage.

BOTTOM A Mississippi field of cabbage.

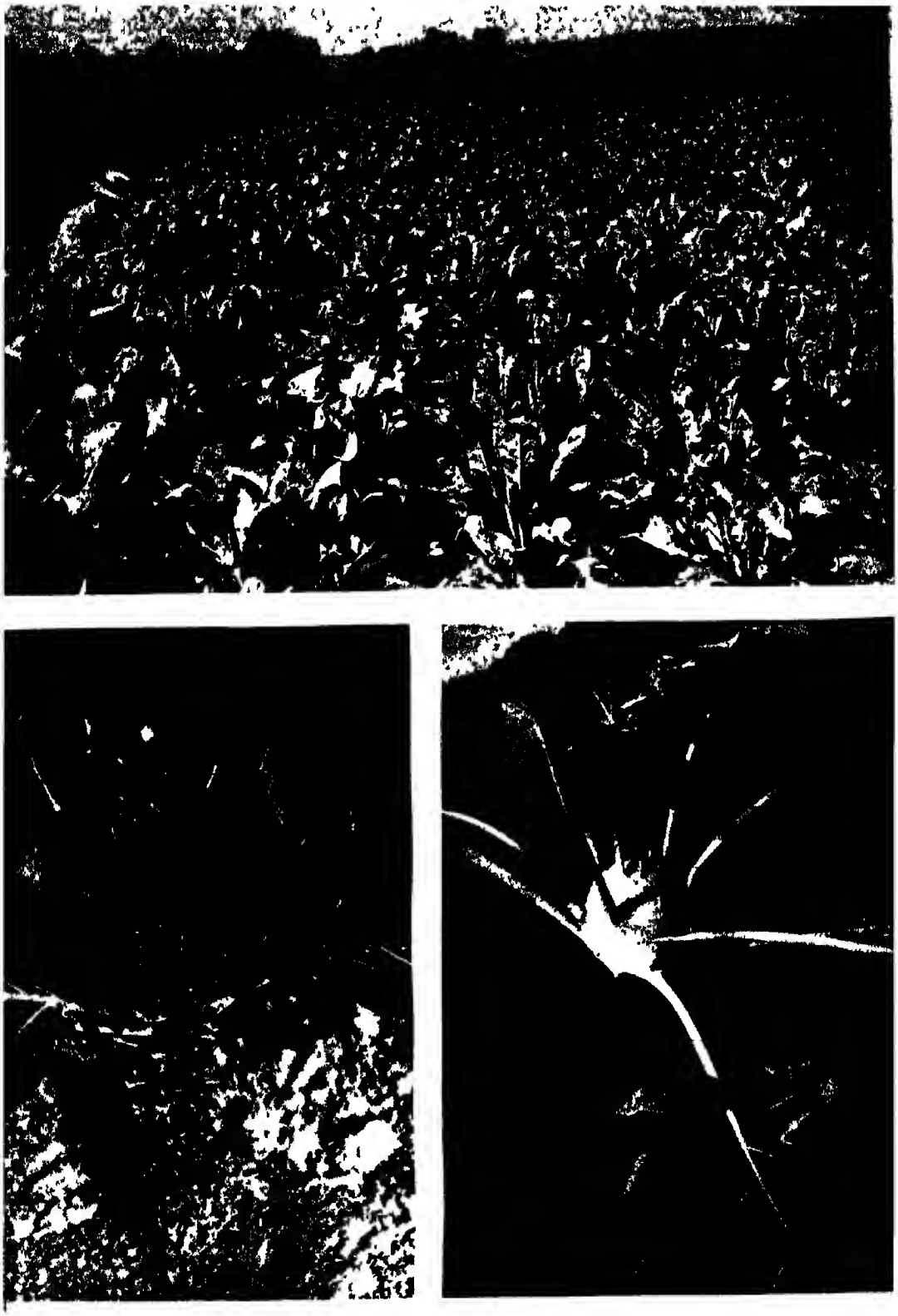

PLATE 30. A field of cauliflower. The leaves enclose the white 'curds.'
LEFT. Brussels sprouts as they grow; the 'sprouts' are actually small side buds.
RIGHT. Kohlrabi, bizarre member of the cabbage group, much resembles a turnip.

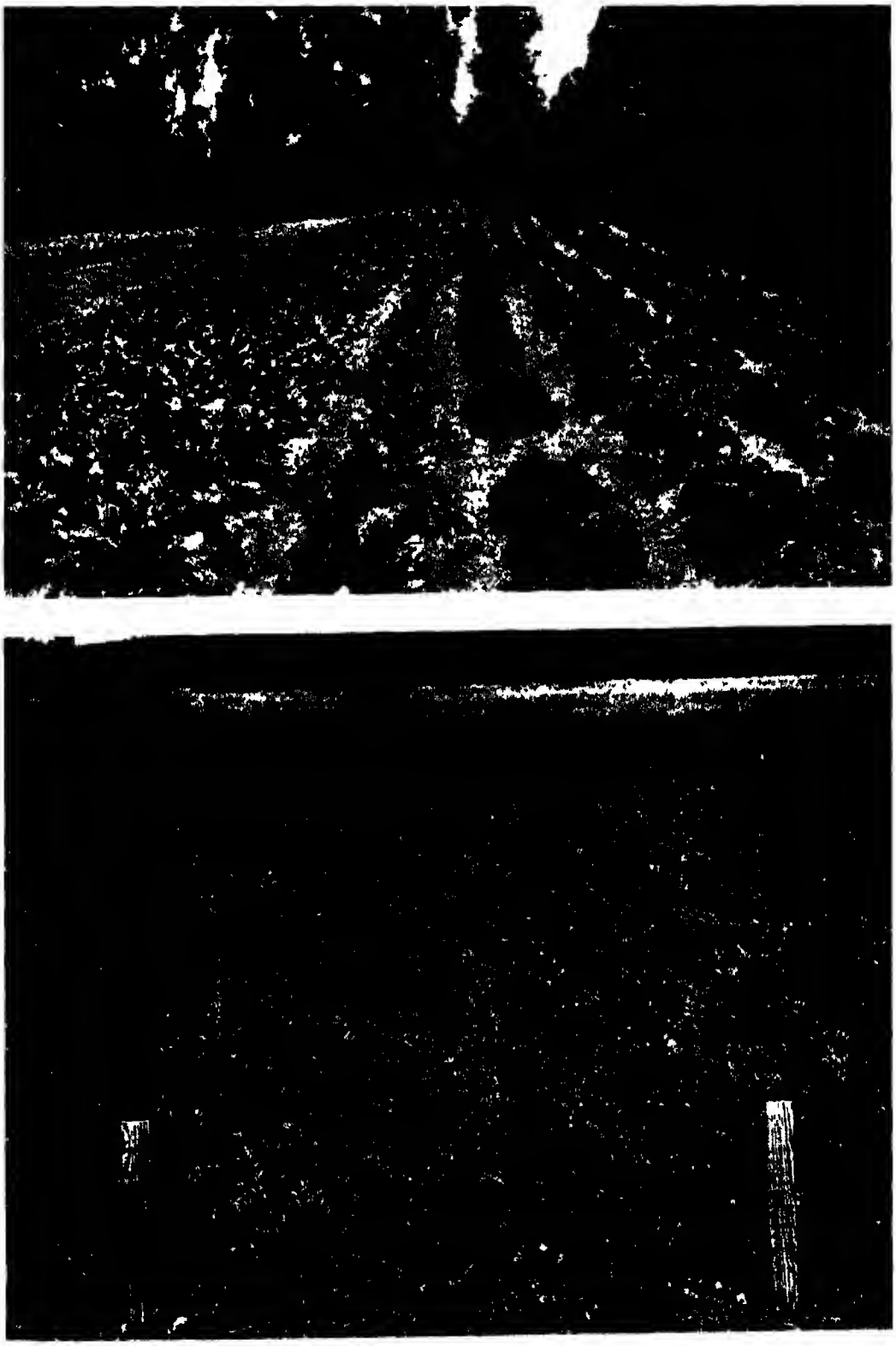

PLATE 31. Beets (left) and kale (right) on a Maryland truck farm.
BOTTOM. A good field of carrots about ready for pulling.

PLATE 32 An Oregon celery field, the plants are being blanched by heaping dirt along the leaf stems.

BOTTOM Cucumbers as they grow, in the South.

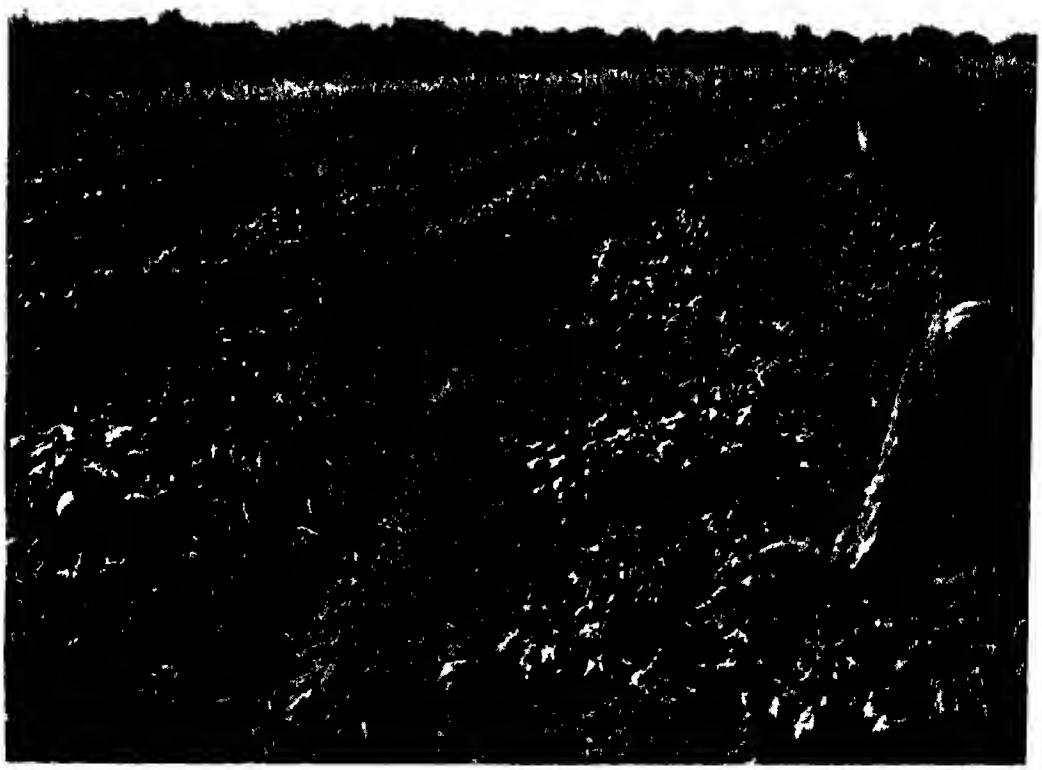

PLATE 33. Iceberg lettuce in a New York truck crop field.
BOTTOM Muskmelons as they grow.

PLATE 34. LEFT. Onions raised for bulbs, before they go to seed.

RIGHT. Onion seed about ready to harvest.

BOTTOM. Red peppers drying in the sun of the Southwest. The Indian woman is husking multicolored ears of corn.

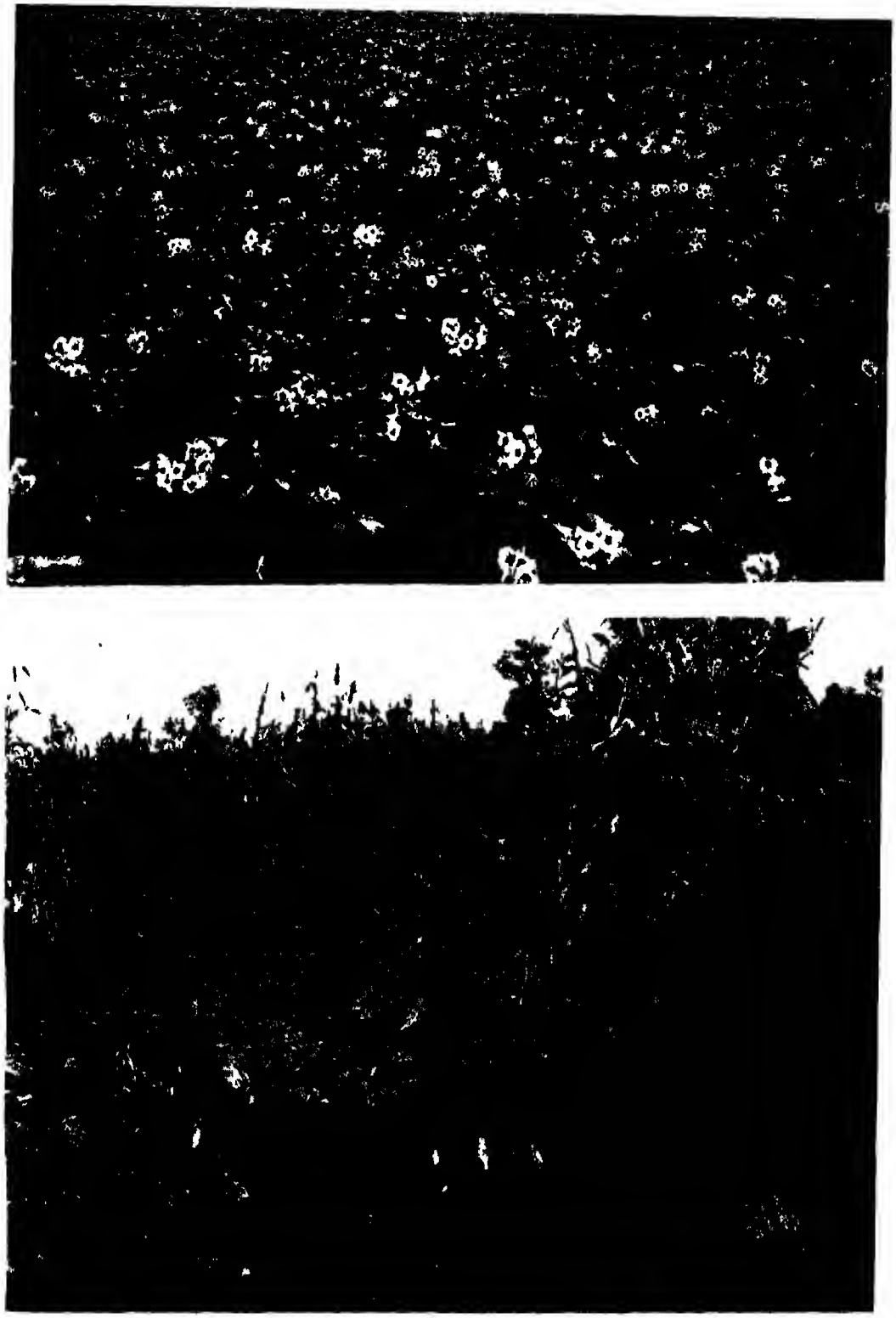

PLATE 35. A field of potatoes in full bloom in the Aroostook Valley of Maine.
BOTTOM. Pumpkins, often combined with corn, are widely grown, but most easily seen in the fall.

PLATE 36. A field of rhubarb in full bloom The leaf stems are the parts eaten, but sometimes these plants are grown for ornament.

BOTTOM A field of spinach grown with the help of an overhead irrigation system.

vegetable crops so far as climate is concerned. Eight or ten thousand acres of it are grown in California, and one occasionally sees the plants elsewhere, especially in the South. Originally this species came from the Mediterranean region and the Canary Islands, where it still grows wild. In this country globe artichokes are increasing in popularity as people learn how to eat them, but they have not been with us very long.

### Asparagus

The chances are pretty good that the traveler who has never seen growing asparagus will miss it the first few times because he will be looking for something resembling the asparagus shoots served on the table. But most of the season, asparagus plants look like big bushy ferns resembling the so-called asparagus fern the florists put in bouquets (Plate 28). Parenthetically we should note that asparagus as well as asparagus fern are in the Lily family and are not related to ferns at all closely.

Every year on some 125,000 acres the asparagus roots send up juicy succulent shoots. Before they have a chance to develop, they are cut off. If the shoots develop in the light, they are green; if the soil is banked up around them and they develop in the dark, they are white, much like celery. After as many young shoots have been cut off as the grower thinks the plants can stand, the later shoots are let grow to become three or four feet high, bushy, and somewhat woody. The plants bloom with minute white flowers and at the end of the season produce a crop of red berries of some interest to birds.

Asparagus still grows wild in Europe and western Asia and it has taken to growing wild in this country also. We have had it since early times, and the Romans were very fond of it. In this country we grow it principally in the hot interior valleys along the West

Coast, in the Upper Mississippi Valley, and along the central Atlantic Coast. Most of the white asparagus for canning comes from California.

### Beets

It may seem peculiar to begin this section by discussing Swiss chard, but chard is the oldest type of beet and was what Aristotle meant in 350 B.C. when he wrote about Beta (Plate 29). In those days the roots were used, but later on the leaves began to be preferred, just as they are still.

About 350 years after Aristotle, the ordinary types of beets seem to have been used as food, but a really improved variety didn't appear until the middle of the 1500's. But even then the kinds of beets in general use were a pretty mixed lot. Some of them were raised principally for cattle feed and were called mangel-wurzels. We know now that mangels developed from chard and that eventually sugar beets were in turn developed from mangel-wurzels. Sugar beets we have already discussed in Chapter 6. All the beets came from the wild beet of the Mediterranean seacoasts and adjacent Europe.

Table beets are grown in nearly every home garden, but the bunched beets in the vegetable market come principally from Texas, Louisiana, and New Jersey. The beets that are canned are grown principally in New York, Michigan, and Wisconsin. The short round storage root is what we use—pickled, boiled, in salads, or canned—although the rest of the fine roots produced by the beet plant may reach five or six feet into the soil. We use the leaves for greens. Altogether, in commercial areas, we grow about 20,000 acres of the ordinary type of red beets—almost a 2-million dollar crop (Plate 31). Chard is a home garden crop, grown only to a limited extent in the commercial gardens, and mangel-wurzels have never been of much importance in this country.

## Cabbage Patch

Along the seacoasts of the British Isles, of Europe, and of northern Africa, there grows wild a coarse weedy plant that looks like nothing in the world anyone would want to eat. And yet, something over 4,000 years ago, someone tried it and apparently found it good, because today we know more than a half dozen excellent table vegetables that owe their existence to the tough old plant of the seacoasts—wild cabbage (Plate 29).

Under cultivation wild cabbage changed very considerably. It changed so much, in fact, that anyone but an expert botanist would have difficulty recognizing its offspring. However, it is now generally believed that from weedy old wild cabbage came brussels sprouts, cauliflower, broccoli, kohlrabi, kale, collards, and, of course, cabbage itself. As they grow, these plants resemble each other very little, yet there is a certain similarity in flavor, regardless of sauces and manner of cooking, that may betray their common origin.

Probably kale and collards are the oldest types, say the scientists, because they resemble their ancestor more than other members of the cabbage group do. They are much more leafy than their wild ancestor, but they are open in growth and quite coarse. The large wrinkled or ruffed leaves are usually boiled as green vegetables or used for feeding livestock. The old Romans knew about these plants, just as they knew and used several kinds of cabbages. Actually much less kale is grown in the United States than in other countries, and what we grow may be found chiefly along the middle Atlantic Coast (Plate 31). A trip through the Norfolk region of Virginia—center of commercial production—at the right time of year would be almost certain to yield a good view of kale fields. There it is sown in late summer or early fall, and cut and shipped off to market in winter or very early spring. Collards are

grown almost entirely in the South, principally in small gardens.

Cabbage is another story, since some of it is grown on a commercial scale in all 48 States (Plate 29). Ordinarily about 180,000 acres are devoted to cabbage—commercial cabbage, that is—to say nothing of all the cabbages grown in city and farm gardens. Most of it we use directly as cabbage, raw (slaw) or cooked, but a substantial quantity of it is fermented every year to make sauerkraut. Cabbage plants are really big buds, and they grow best in a cool climate. There are a great many kinds, some with smooth leaves, others with blistered leaves, and there are both red and green varieties. To take advantage of the coolness of climate that the plants require, cabbage is grown as a summer crop in the North, as a winter crop in the South, and as a spring or fall crop in the in-between States. If by any chance you were looking for cabbage, you would be most likely to see it in New York, Florida, Texas, or Wisconsin, because these States usually lead the rest in acreage.

Cauliflower—one of the few flowers we eat—has nowhere near the wide range that cabbage has, so that it is seldom seen from the roadside. It takes considerable skill, and exactly the right conditions to grow good cauliflower. Too intense sun, for instance, turns the heads brown, so that the leaves are sometimes tied together at the top to keep the mass of flowers white (Plate 30). It is to be found growing in cool, mild, moist areas principally in California, Colorado, and Long Island, New York. A little is grown also in Arizona, the Northwest, Texas, New Jersey, and Utah. Altogether we grow nearly 30,000 acres of it each year—not much land perhaps, but some 10 million crates of flowers just the same.

Broccoli comes in two ways. One type, known as heading broccoli, looks like cauliflower and takes about the same special conditions to grow. This is the 'cauliflower' Easterners get in the wintertime from the West Coast. The other type, known as sprouting broccoli, is what people mean when they ask for broccoli at the

grocery store. Sprouting broccoli grows anywhere cabbage can grow, and is also a vegetable we value for its flowers. In fact, we eat flowers, buds, leaves, and the top of the stem as well. We grow much more of it than we used to, and although it was formerly grown in the same areas as cauliflower, it is now being grown more generally.

Kohlrabi, reminiscent of turnips except that this 'turnip' develops above ground and has leaves on it, is used mostly for feeding livestock in this country (Plate 30). This is one member of the cabbage family that may not have developed from wild cabbage; nobody knows for sure. It is a collector's item for the traveler because there is not much of it to be seen from the American roadside.

Brussels sprouts are apparently the youngest of the cabbage group. They are thought to have been developed in Belgium and are possibly only a few hundred years old. Brussels sprouts stems are much elongated and the little sprouts develop all along the stem like so many little cabbages (Plate 30). They are more tender and have a more delicate flavor than cabbage does. Cool weather improves their eating qualities, and the plants are grown principally along the middle Atlantic Coast in about the same areas as kale. Eastern Long Island produces a great deal. So does the Half Moon Bay region of California.

## Carrots

Wild carrots grow along our roadsides in many parts of the United States, but they came originally from western Asia. Supposedly, the Indians spread carrots over much of this country, but be that as it may, we now grow carrots in gardens nearly everywhere. The kind we grow for the roots came from Europe, where Vilmorin, famous French plantsman, improved carrots so remarkably in the last century. We raise 45,000 acres or more in the com-

mercial centers in California, Arizona, and Texas, and most of our crop is grown under irrigation (Plate 31).

When it rains too much, carrots lose their 'carroty' color. Where they are irrigated, the water content of the soil can be regulated so that good color can be developed. That is why fewer carrots are grown in the East than in the drier, irrigated valleys of the West. The color comes from carotene, a red-orange pigment that can be extracted and used for coloring butter to make it look rich.

A field of carrots in bloom—where the plants are raised for seed—is rather pretty. Along the roads or in poor hay meadows, people sometimes pick the blooms for bouquets. They call them Queen-Anne's lace.

## Celery

Celery growing, according to the Department of Agriculture, is one of the most highly specialized, expensive, and difficult of all vegetable enterprises. In the wild state, celery prefers marshy, wet places; hence in cultivation it does best in peat or muck soils reclaimed from bogs and swamps. It is very fussy about temperature, and there must be plenty of moisture. If it gets too cold, then warm, the plants are likely to 'bolt'—meaning they will go to seed—which is not what growers want unless they are raising seed.

For all that, we grow some 40,000 acres of celery in the big producing centers of 13 States, in the North and in the South, and in Florida and California. Besides these, celery is grown in almost every other State, so that the chances of seeing it from the roadside are fairly good.

Celery is usually sown in beds, then transplanted to field rows. As the plants get good-sized they are blanched, that is, the lower parts of the stems are covered up so they will turn white. The plants may be covered with boards or paper, or the soil is banked up around them (Plate 32). Sometimes the celery is picked green and blanched in dark cellars or with ethylene gas, which is also

used to ripen oranges. Blanching improves quality, but there are green celeries on the market that make their own bid for success.

Celery grows wild in Europe and southern Asia, but from all the evidence available it has not been in use for very many centuries, except possibly as a medicine. The leaves were also used in Europe for flavoring and as a garnish (like parsley). One European variety with a large root is called celeriac. In this country we grow celery only for its leaf-stems and for its seed, which we use to make soups more appetizing.

### Cucumbers

A native of Hindustan, cultivated for perhaps 4,000 years, cucumbers are grown in heaviest concentration in the East and the Great Lakes States, although California and Texas grow plenty also. More than half the crop is used to make pickles, and the whole crop is grown on about 130,000 acres of land (Plate 32).

Cucumbers grow pretty well in about the same regions as muskmelons, to which they are fairly closely related. The cultivated plant is in a different genus altogether from the wild cucumber of our wooded thickets. The sweet gherkin, which some books will tell you is only the small cucumber, is actually a separate variety that came to us from Jamaica the same year Eli Whitney invented the cotton gin.

### Eggplant

The chances are small of seeing a field of eggplant in the United States except in Florida, Louisiana, Texas, Virginia, and New Jersey. Even there, chances are poor because it is a minor crop that rarely occupies much more than 4,000 acres in this country. The plant came originally from India, and people in the warmer parts of the world still seem to like it more than we do.

### Endive

Chicory and endive are very closely related, although neither one is grown very extensively in the United States. Both are natives of Europe, probably of the Mediterranean region, and both are used in Europe for salad or greens. Here we grow endive for its curled and twisted leaves, usually near big cities.

Chicory is a common straggling weed with sky-blue flowers, likely to be found along the road almost anywhere. The roasted roots are ground to make what books call an adulterant of coffee. In parts of the South, where coffee may be used principally as an adulterant of chicory, such a statement is very properly discounted.

### Lettuce

Lettuce was served on the royal tables of the Persian kings several centuries before the Christian Era, and it is certainly still in royal favor now as a salad plant. We grow quite a lot of it—on about 160,000 acres of land. The western States grow about 85 per cent of it and what they grow is principally iceberg lettuce. This is the lettuce the Europeans call Neapolitan cabbage; it is usually the lettuce you buy in the market with white, crisp, solid heads (Plate 33). In the East the principal variety used to be Big Boston, which has smooth, not crisp, leaves of the 'butter' type. Recently, however, because the public insisted on it, the eastern growers have had to change over to types like the iceberg.

A kind of lettuce grows wild in parts of the United States as a weed in cultivated land. It came from Europe and Near Asia, and from breeding experiments it looks as though it is the ancestor of cultivated lettuce. Lettuce can be seen in almost any garden, but you will see more in California than anywhere else.

## Muskmelon

All canteloups are muskmelons, but not all muskmelons are canteloups; in fact, the true canteloup is a hard, warty-looking melon that is practically unknown in this country. However, muskmelons, which we grow in quantity, have been called canteloups so much that even the experts are beginning to give up trying to keep the two things separate. Castle Canteloupo, near Rome, Italy, is where true canteloup melons originated. Our melons are classed as netted or nutmeg melons, but they are still called muskmelons for all that.

We grow about 130,000 acres of muskmelons each year, scattered over a good many States in the truck-crop regions (Plate 33). The most concentrated acreage is probably in the irrigated Southwest. Originally our muskmelons came from the Near East, and they are in the same family as cucumbers, watermelons, and pumpkins.

## Mustard

Mustard ought not to be included among vegetables because we use it either as a cover crop or for medicine or a flavoring material. You can always spot a field of mustard because it is a continuous yellow sheet of flowers when it blooms. In California, where it is planted a good deal in orchards, it is plowed under about the time it is blooming, for fertilizer. In Montana, you can see great fields of mustard some years, for it is there that mustard is grown so extensively for seed, whenever there is a good demand for the product. There is some mustard in Wisconsin, grown for bird seed. One type of mustard is a common weed in this country, although it is grown to some extent in Kentucky and California. Originally mustard came from Eurasia.

### Okra

Okra is closely related to cotton and is grown most in the cotton regions. Introduced from Ethiopia along with African slaves, it was called 'gumbo.' Chicken gumbo soup is chicken soup with okra. Not much is grown commercially, but it is a rare farm in the South that doesn't have some okra on the place somewhere. It looks very much like cotton as it grows, except that its leaves are shaped like an open hand with fingers extended. It has very showy flowers and long pods.

### Onions

Eight species of onions are cultivated in this country. Two are flowers, the rest include garlic, leek, shallot, chives, Welsh or Japanese onions, and the ordinary onion. We grow a little garlic and some leek in central California, chives in many herb gardens, and about 5,000 acres of shallots in Louisiana, but ordinary onions we produce on about 120,000 acres yearly, besides planting them in nearly every home garden.

Onions are native to southern Asia or the Mediterranean region and have been cultivated for upwards of 4,000 years. We grow them principally in the truck-crop regions mentioned at the beginning of this chapter (Plate 34). Onions and garlic look pretty much alike in the field, but garlic has flat leaves while onions have round, hollow ones.

### Oyster Plant

Salsify, or oyster plant, is of little importance in the United States. It is a rather fleshy plant with large purple flowers and seeds resembling those of dandelions. The root flavor suggests oysters. The plant came from southern Europe. It is a weed in some places in this country, and nearly all our crop comes from a narrow strip along the central California coast.

## Parsnips

The parsnip originated in the Mediterranean region of Europe, and after it was introduced into this country it went wild along the roadsides. These wild plants will resume their cultivated form if they are returned to cultivation, in a Jekyll-Hyde manner. Parsnip seed is grown principally in California. Commercially speaking, we grow parsnips in market gardens near our big cities, but the total amount of land we use to do it is relatively small.

## Peppers

This section has nothing to do with black or white peppers, which are not grown in this country; it deals with red peppers—the cayennes, chilis, paprikas, capsicums, pimientos, tabascos, and sweet peppers native originally to the American tropics. Christopher Columbus is supposed to have taken peppers back to Europe from the West Indies, and this is the first time white people knew anything about them. The native Americans had all the types of peppers in current use today, however, even though we have improved them, and had apparently been growing them for quite a long time, perhaps many centuries.

More than 35,000 acres of peppers of one kind or another are grown in the United States (Plate 34). Roughly half the land is used to grow pimientos, and most of the pepper-growing is carried on in the Atlantic and Gulf States and California. Over 90 per cent of the pimientos are grown in Georgia. Tabasco peppers are grown chiefly in Louisiana, and chili peppers in the Southwest.

## Potato

Although the ordinary white potato did not get into general use in the world until after 1700, it is the most important crop in all the world at the present time, measured by the bushels produced.

This is a remarkable record to have made in less than 300 years. The really big production is in Europe, where more than 90 per cent of the world's potato crop is harvested. Here we grow upwards of 390 million bushels on a little over 3 million acres.

There are a number of species of potatoes, one of which is native to the southwestern United States, but the important one we grow —the so-called Irish potato—came from Chile in the beginning. Again we have to thank the Incan civilization of the west coast of South America for a food plant of such great importance. The early Spaniards found the South American natives using potatoes when the New World was being invaded, and it is believed the Spanish took the vegetable to Europe on their return.

Potato-growing generally failed to flourish in the Old World until famines forced people to turn to the New World crop. Ireland took it up possibly earlier than other countries, and when the Irish began immigrating to the United States, they brought 'Irish potatoes' with them. According to our best authorities, potatoes were first grown in this country at Londonderry, New Hampshire, in 1719. For 30 years after that, the Irish continued to bring potatoes into the United States, and the culture of 'Irish potatoes' grew in volume.

Most of our potato varieties have been produced from seed—true seed, not 'seed potatoes.' The potato plant will produce seed under certain conditions, but the seed balls are by no means common. The famous Burbank potato, for instance, was developed from a seed ball Luther Burbank found in 1871. The potato seed ball looks very much like a small tomato, and well it may, since tomatoes are closely related to potatoes.

At the present time potatoes are said to be grown in all but seven counties in the United States. Important production in the East, however, is in the Aroostook region of Maine, Long Island, New Jersey, Pennsylvania, and the eastern shore of Maryland

(Plate 35). To the westward, Michigan, Minnesota, Wisconsin, and Idaho grow large quantities of this important vegetable. Maine leads all the States, and there, as in most other States, the culture is in rows rather than in little hills as the Incas grew them, although many potatoes are still grown in hills as they have been for many, many centuries.

### Pumpkin

There is uncertainty among the botanists not only about the difference between pumpkins and squashes, but about the place of origin of both. It used to be believed that these plants came from Africa, then for a while New England was claimed as the birthplace. Recent studies point to South America as the home of the pumpkin, and Central America for the squash. And there is no longer doubt that these plants are from the New World; after all, the Indians had them before white men got here.

Both pumpkins and squashes are widely grown in the United States, sometimes in fields of their own, sometimes along with corn (Plate 35). They are not an important crop as vegetables go because they do not occupy a tremendous acreage, but we value the part they play in our diet nevertheless.

### Radish

The radish is believed to have come originally from China and India, and it is known to have been cultivated by the ancient Greeks and Romans. It has a rather low food value and is grown either in home gardens or the market gardens near big cities. There are a number of kinds. The early radishes are small and last only a short time. The winter radishes are large and store well. In bloom, radishes have a purple flower and are rather attractive, although coarse and weedy. They are most easily seen in Michigan or California, where most of our radish seed is grown.

### Rhubarb

Rhubarb, which is closely related to buckwheat, has been somewhat of a puzzle to botanists, who disagree about its proper Latin name. This is one reason why some books will tell you it originated in Asia and others will state it came from the Mediterranean region. Rhubarb-growing in this country is largely restricted to regions north of the Potomac and Ohio Rivers and to the coastal regions of California (Plate 36). Where the temperatures are lower, the stalks develop a red color; where the climate is warmer, the stalks are usually green.

### Spinach

Spinach has been grown for some 2,000 years, but it has never been as important as it has become recently. Its closest vegetable relative is the beet, but spinach is the principal source of greens. We grow some 75,000 acres of it in the truck-crop regions of this country, with leading production from Texas, California, Virginia, and Maryland (Plate 36). The plant came originally from southwestern Asia.

### Sweet Potato

There are several hundred species of morning glory (Ipomea) but only one produces edible roots, and that is the sweet potato. This plant is entirely different from the yam, which we use only for cattle feed and of which we grow very little in the Deep South. In the vegetable markets the moist, soft, orange-yellow sweet potatoes are often called yams, while the dry, mealy, light-yellow kinds are called sweet potatoes, but both these tubers are the same.

The sweet potato came from South America, although most of our varieties were introduced from the West Indies. Thanks to the Incas, the sweet potato is now widely grown in warm countries. In the United States we grow about 800,000 acres of the plant in the

more southerly States, both east and west, and along the central Atlantic coast. The plant is a vine that sprawls on the ground and that in this country seldom flowers and rarely produces seed (Plate 37).

## Tomato

For a long time after the early Spanish explorers took tomatoes back to Europe, people were afraid to eat them. The English grew them as an ornamental only, in the seventeenth century. In the eighteenth century the Italians grew them on a field scale, but the century was half over before we dared to eat tomatoes in the United States. Love apples, people called them, and poisonous.

But all that is past history now. We devote more than half a million acres of land to tomatoes in the United States. The plants are grown in every State, and in Florida, California, and Texas, they are grown the year round. The plants are sensitive to frost, having originated in the American tropics, but they do well even where there is no more than a 4-month frost-free season.

In the field you may see tomatoes with or without stakes, although tying the plants to poles is not as common a practice as it used to be (Plate 37). There is an astonishing variety; the fruits may be red, purple, orange-yellow, lemon-yellow, or cream color, large or small, and the plants may be dwarf or large. Usually the plants are transplanted from seed beds to the field, although sometimes the seed is sown directly.

Besides tomato ketchup, tomato juice, tomato paste, chili sauce, tomato pickles, tomato preserves, tomato relish, cooked tomatoes, and raw tomatoes, we get tomato oil and tomato cake. The cake comes from the canning factories where the skins, cores, and seeds are taken out, and after expressing the oil, the cake is used for cattle feed. Love apples, people called them, and poisonous.

### Turnip

Although turnips and rutabagas are so closely related that they are sometimes classed as varieties of a single species, rutabagas grow best in the northern part of the country but turnips are grown in every State. The plant(s) came originally from temperate Europe and as far as anyone knows have been cultivated for possibly 4,000 years. Rutabagas are called swedes by some. They are larger than turnips and have a more solid flesh; hence they keep better. In bloom, turnip plants with yellow-fleshed roots have pale orange-yellow flowers; the white-fleshed plants have bright yellow flowers (Plate 38).

### Watermelon

Nobody thinks about watermelon, at least in the North, until hot weather arrives. By that time, in the Southeast or Southwest there has been enough hot weather so that the melons are ready—because watermelons are hot-weather plants native to Africa. And each year we raise between 65 and 80 million watermelons on some 270,000 acres (Plate 38).

The watermelon has been cultivated for several thousand years, people guess, although there may just be a little uncertainty about this. Early explorers in the United States came upon Indians in the Mississippi Valley who had watermelons—or perhaps they were citron melons, close relatives but not the true watermelon. At any rate there is a Sanskrit word for watermelon and watermelons figure in Egyptian paintings, evidence that seems to clinch their Old World origin.

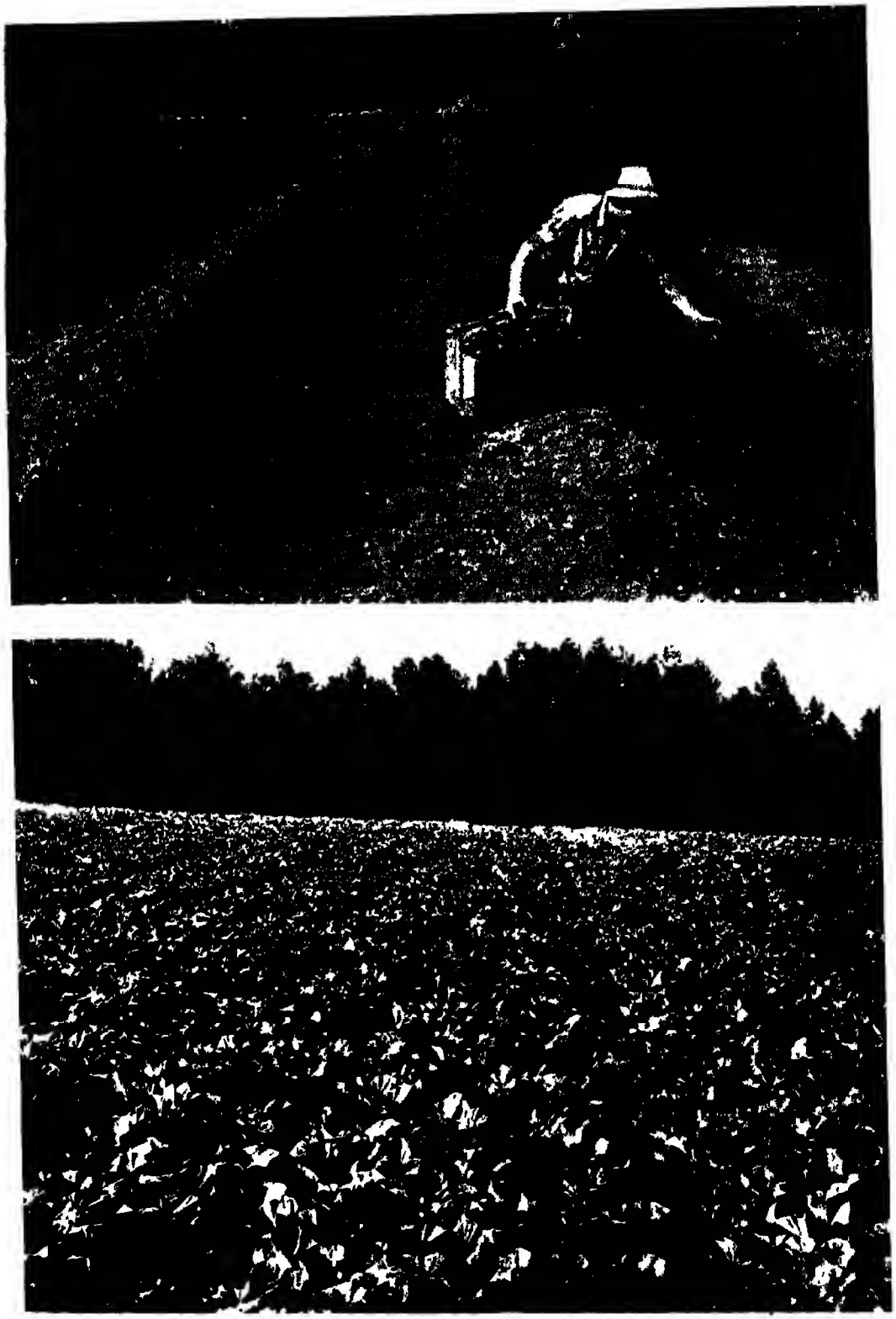

PLATE 37. Tomatoes, here grown without stakes.

BOTTOM. Sweet potato vines covering a North Carolina field. Indistinct traces of the rows can be seen.

PLATE 38. Turnip field in Oregon.

BOTTOM. Cuban Queen watermelons in a Carolina field. Men are sampling melons to determine ripeness.

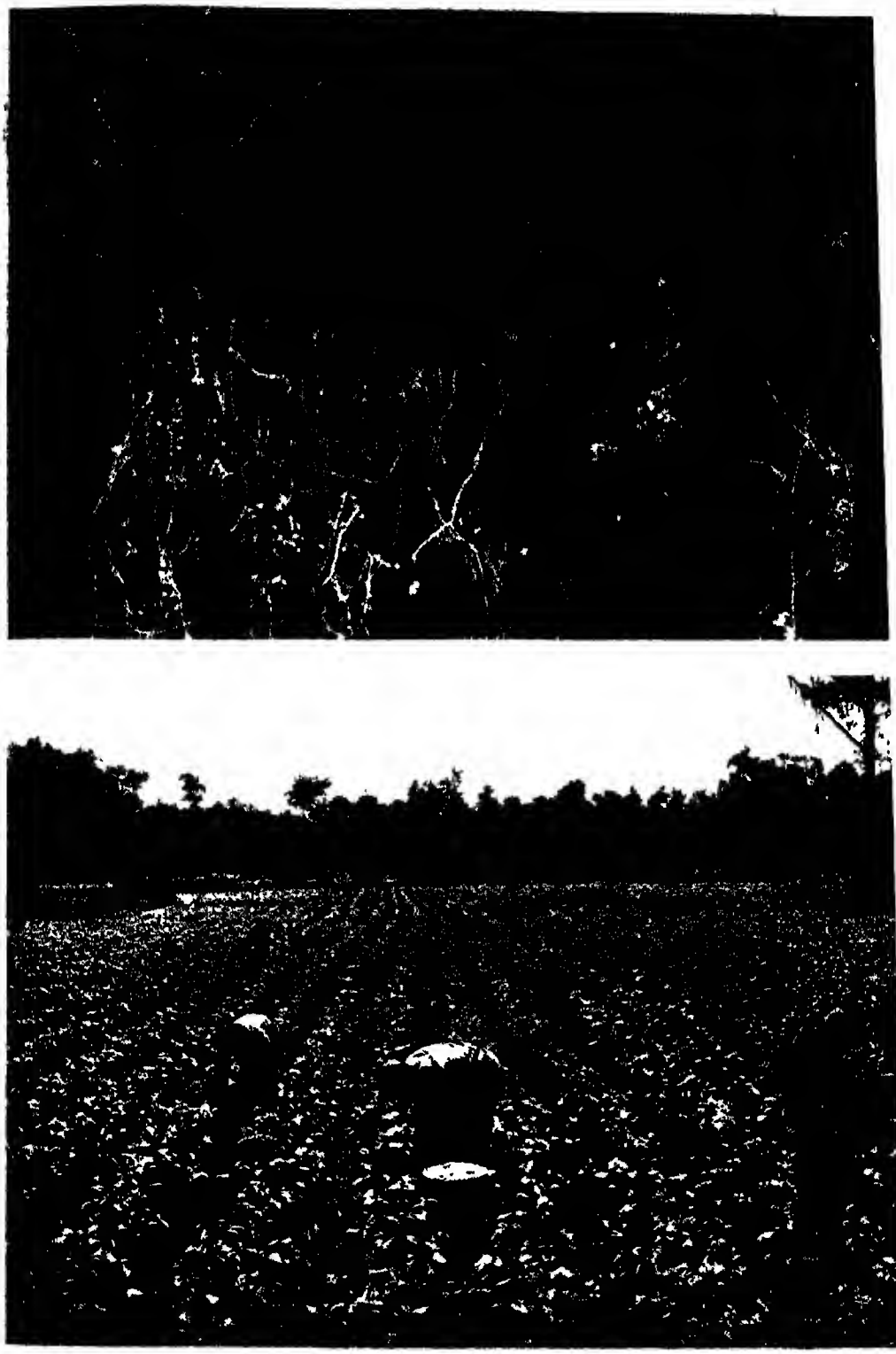

PLATE 39. Pulled gently from the soil and rinsed in water, the roots of this legume display the remarkable nodules containing nitrogen-collecting bacteria.

BOTTOM. Harvesting a field of wax beans in Florida.

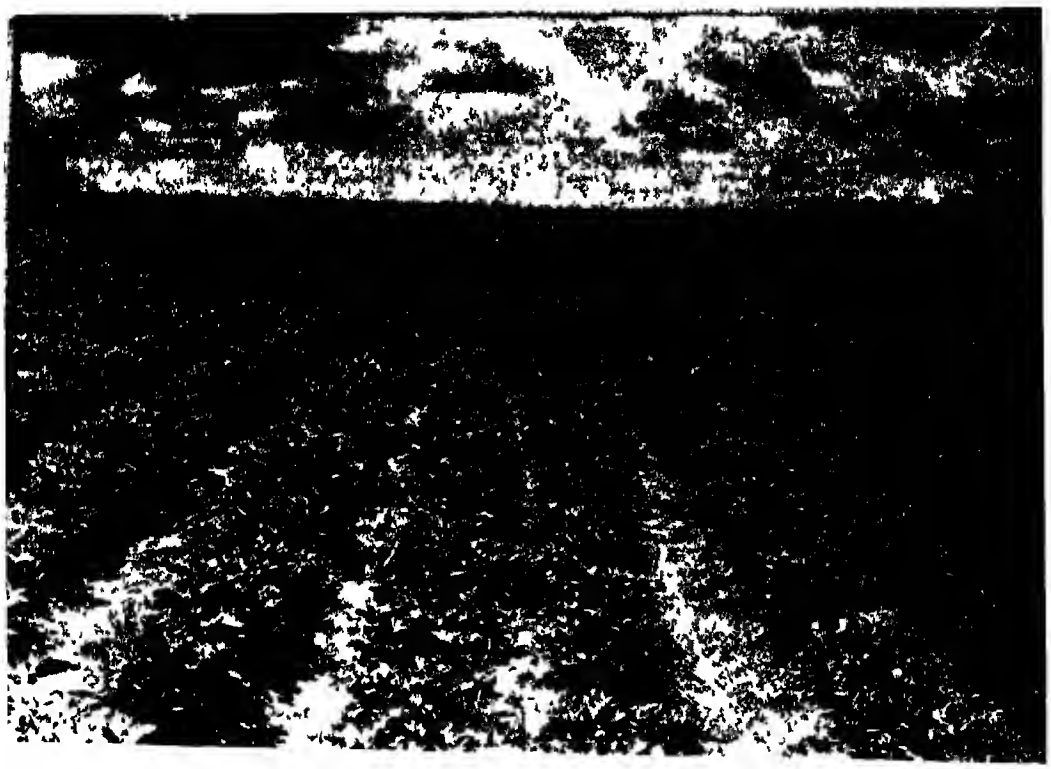

PLATE 40. A fine crop of peanuts on sandy land in Florida
BOTTOM. Peanut stacks, characteristic in shape, in which the peanuts dry.

PLATE 41. A field hand stacks peanut vines.

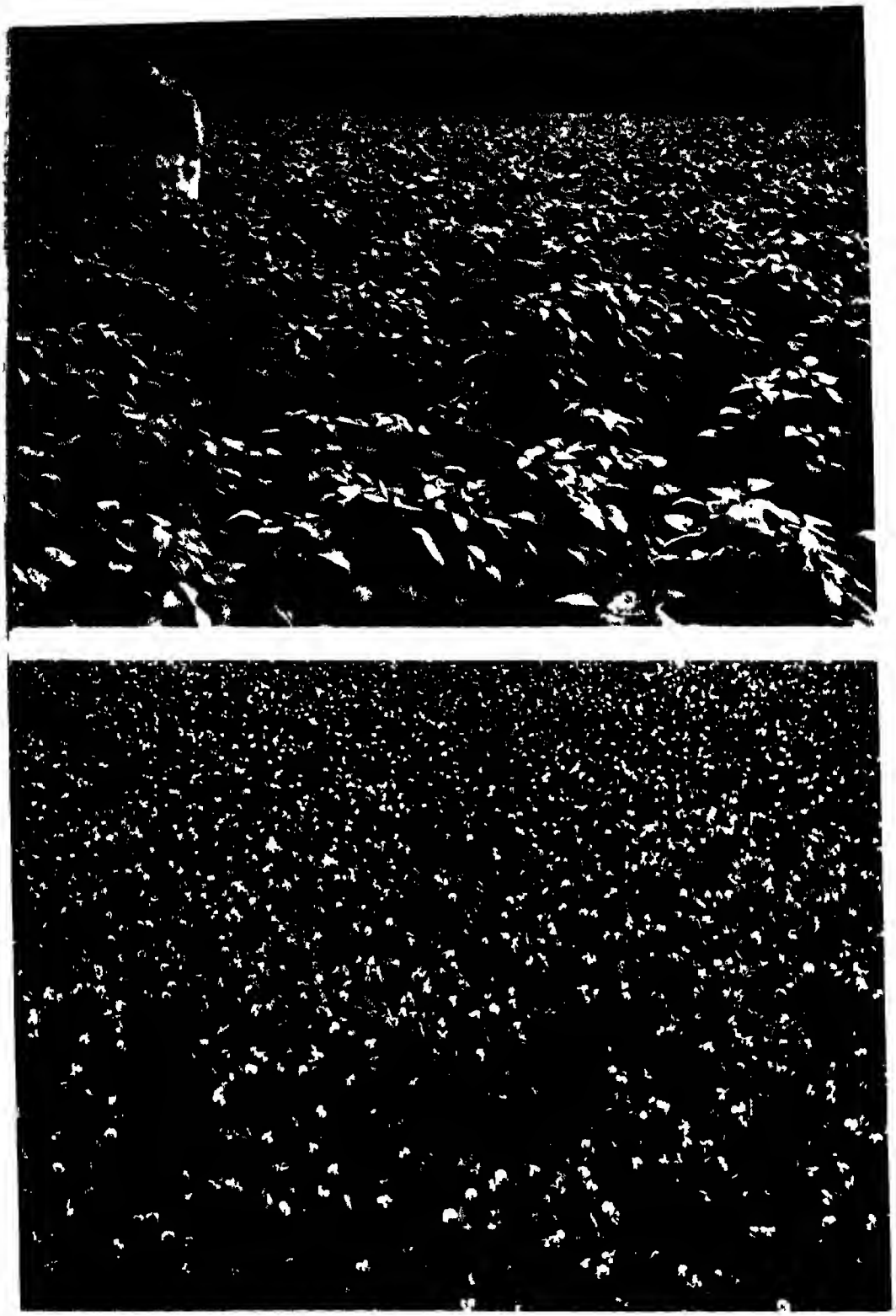

PLATE 42. Soybeans in the field resemble green bean plants, but are somewhat leafier and more robust.

BOTTOM A field of canning peas in bloom in Maryland.

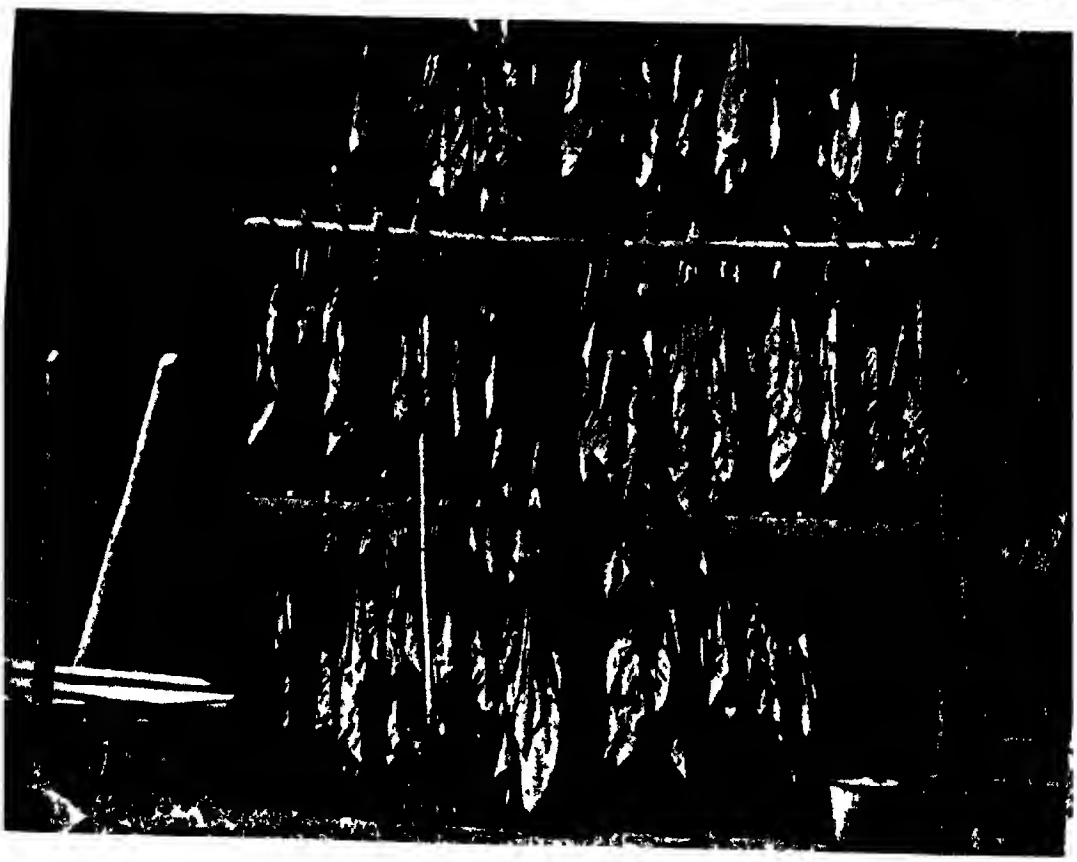

PLATE 43. Tobacco in the field.
BOTTOM Tobacco in the barn, drying and curing.

PLATE 44 A shaded field ready for tobacco planting in Connecticut.
BOTTOM. Stacks of high-quality hay for cattle feed in Nevada, raised on irrigated land.

X

# THE GREAT FAMILY OF LEGUMES

For more than twelve centuries the curious idea kept appearing here and there among the world's farmers that certain kinds of plants actually improved the soil. Crops like vetch or beans or clover, they insisted, would actually increase the fertility of the land. The ancient Greeks noticed this, and one of their number wrote about such plants 'reinvigorating the ground.' The Romans noticed it also, and went on record rather extensively about the value of sowing alfalfa or beans so as to make the soil more fertile. Farmers of medieval Europe seem to have been convinced of the same thing. And when the European explorers arrived in the New World, sure enough, the American Indians were found to be raising beans among their corn plants.

All this may not, at first sight, seem very remarkable, yet everybody who tilled the soil knew perfectly well that to grow grain, for instance, sooner or later you had to use some kind of fertilizer if you expected any kind of a crop. Yet here were plants like beans, peas, clover, alfalfa and vetch that acted quite differently. Instead of using up the plant food in the soil, as most plants do, they added to it. Truly, here was a fact of considerable importance, because, by growing beans one year and wheat the next, you could increase the yield of the wheat just as though you had added fertilizer.

Now it happens that beans, peas, vetch, clover, and alfalfa all belong in the same plant family. This great family also contains many other well-known plants such as peanuts, locusts, indigo,

acacias, mimosas, and a host of valuable timber trees and food-producing plants of the tropics. The family is known as the Legume Family, and is so called because all of its members produce their seeds in characteristic pods or legumes such as those of the garden pea. Here then was a group of plants that were closely related and that seemed to possess a very remarkable character. Science could offer no explanation, yet the fact remained that the plants known as legumes could improve the soil in which they were grown.

Well, about 1888 the scientists found out how the legumes did it. In a series of researches by a number of men it was discovered that the legumes were able to make use of the valuable element, nitrogen, in the air. Other plants could not do this, but must depend for their nitrogen on certain compounds of it in the soil. The legumes could not themselves extract nitrogen from the atmosphere, but relied for this service upon bacteria which formed small nodules on their roots. These root-nodules can be seen if a clover plant or other legume is carefully pulled out of loose soil (Plate 39). They are to be found on all but a very few legumes, and they contain from a hundred million to a billion bacteria each. The bacteria are to be found ordinarily in soil, whence they manage to make their way into the legume roots. If they are not present, the legumes will not thrive as they will where the tiny organisms can, so to speak, set up housekeeping in their roots.

We use legumes for a variety of purposes in the United States, and we can measure the value, in dollars, of the legume harvest. But the great value of legumes resides in their fertilizing effect on soil, and this no one has even calculated, although all agriculturists recognize it to be tremendous. We grow legumes for hay or seed on at least 70 million acres of land. When we harvest the plants and take them off the land, the fertilizing effect is not as great as it would be if the plants were plowed under, but it is considerable nevertheless. On how many millions of acres legumes are grown,

then plowed under, we have no estimates. Besides this, the millions of acres of pasture and meadow that contain legumes are not certainly known. Yet it is reasonably safe to say that all the acres on which legumes are grown run into several hundred millions in this country. It is also safe to say that we could double the acreage with profit—to the soil and the farmer both.

For any of these plants to do their best, the bacteria that form nodules on their roots must be present. If the bacteria are already there, farmers do nothing about it, but if they are not, it is a common practice to put them there. There are commercial concerns that specialize in the development of legume bacteria of various strains. These legume inoculants, as they are called, are sold to be scattered on the fields where legumes are to be grown.

## Legumes for Food

The legumes we grow in this country are planted with one of three ends in view. We use their seeds for human food; we feed them to livestock, either in pastures or as hay; and we plant them on purpose to plow them into the soil as fertilizer. Plants such as vetch, alfalfa, and the clovers are used extensively for livestock, and the story of these plants is reserved for Chapter 12.

The legumes we eat include garden peas, garden beans, field peas, chick peas, soybeans, lima beans, and peanuts. The seeds of these plants are highly nutritious. Seeds of most legumes are particularly rich in protein and are nearer to meat in food value than any other vegetable product. By way of comparison, a pound of peanut butter has three times the calory value of a pound of beef.

## Common Beans and Lima Beans

The common beans we grow for food in the United States all came originally from South America, where the Incas had used them for many centuries. They were being grown also by the In-

dians in North America, who planted them in their corn, as we noticed earlier. *Frijoles* the Mexicans call them now, and as kidney beans the English know them. They are used for their seeds (dried or shelled green) and for their young pods, as string beans or snap beans (Plate 39).

Until the discovery of the New World these beans were unknown in Europe, but they are now grown on a major scale both here and in the Old World. We plant string beans in most of the States except those in the Great Plains, and use more than 200,000 acres to do the job. Dry beans are an even more important crop, being grown on about a million and a half acres. Most of the land used for dry beans in the East lies north of the latitude of Boston. In the West, dry beans are grown anywhere the mean temperature for August goes no higher than 70 degrees (Plate 61).

There are a great many varieties. Some kinds climb like a vine, and are grown on poles. Others are bushy and support themselves. The pods may be green, or yellow as the wax beans are. The seeds may be truly 'bean-shaped,' that is, kidney-shaped, or nearly round, and they come black, red, pink, yellow, or white, with or without spots or markings.

Limas are the beans with the big flat seeds—butter beans some call them. They, too, came from South America, and although they are closely related to common beans, the two species have never been crossed.

The biggest of the lima beans was brought from Lima, Peru, by Captain John Harris of the United States Navy in 1824. We already had some smaller lima beans, but the big one became very popular and is now extensively grown in southern California. Altogether we use about 60,000 acres for green limas, and some 240,000 acres for the dried ones.

## Soybeans

In 1804 a 'curious plant from the Far East' was introduced into the gardens of the United States, where it stayed as a curiosity for many years. The plant was the soybean, which now occupies more than 11 million acres of American land, and which is expected to assume a position in the agricultural world of even greater importance (Plate 42).

Not very much was done with the soybean in the United States until about the end of the last century, when the Department of Agriculture began introducing large numbers of varieties. Before 1898 there were not more than eight types in use, and these—like most soybean varieties—were rather fussy about climate and soil. By this time something over 100 varieties are grown, and although each variety is best adapted to a particular region, the large number of varieties now makes possible more extensive use of soybeans. Needless to say, plant breeders are hard at work developing types that will grow in parts of the country where soybeans have not been grown with much success so far.

Most soybean land is in the eastern part of the United States, although some is in the Southwest. The heaviest production of all is in the Corn Belt, but soybeans are grown extensively in the central Atlantic States also. Because the plant is being used more and more, the chances are good that it will be seen from the roadside even more than is possible now.

The plant came originally from China, and it is very commonly grown there. In Manchuria—'The Land of Beans'—about 25 per cent of the cultivated land is put to soybeans, and Manchuria leads the world in production. There it is grown for its seed; here we have been growing soybeans primarily to feed to livestock or as a fertilizer crop. The chances are good, however, that we will use much more seed than we have formerly.

It would take several pages to list all the uses to which the various products of the soybean are put. We have already mentioned the use of the plants themselves for fertilizer and livestock feed. The oil expressed from the bean goes into foods, such as butter substitutes, cooking and salad oils, candies, and chocolate. Soybean oil is also used in candles, celluloid, disinfectants, paints, insecticides, linoleum, lubricants, rubber substitutes, and soaps—to mention only a few. The soybean meal left after the oil has been taken out is used in beer brewing, soy sauce, and milk substitute, as well as for food for animals, from cattle to dogs and fish. The meal also finds its way into glue, fertilizer, and other industrial products. The beans—oil and all—are used directly in breakfast foods, diabetic foods, icecream cones, children's foods, coffee substitutes, and a host of other things. Salted soybeans are sold just as salted peanuts. And there are many, many more uses for soybeans that augur well for the future of this 'curious plant from the Far East.'

## Peanuts

For the sake of those who have never seen peanuts growing, there are several remarks that must be made to set the record straight. Peanuts are not *nuts* at all; they are legumes just like peapods or beans, except that the pod shell is somewhat woody. Peanuts do not grow on trees but on little herbaceous bushes. And the peanuts themselves develop underground; that is, you dig them as you do potatoes.

Peanuts are grown in this country only in the Southeast, from Arkansas and Virginia south to the Gulf, and you will usually find them on sandy soil. About 3 million acres of land are used for the crop we produce, and we pick and thrash the peanuts on about two-thirds of this land (Plate 40). On the remaining land pigs are turned in on the peanut patch to root out the peanuts and eat them. 'Hogging off' the peanuts is what farmers call this method

of harvesting, and its purpose is, of course, to fatten the animals.

The business of growing peanuts has some interesting angles to it. The seeds are planted early in the spring and the young plants are cultivated just as you would cultivate corn. In due course, two types of flowers appear. The flowers of the top of the plant are yellow and resemble yellow sweet peas. They are rather showy, and after a time they wither and fall off. Down toward the lower parts of the plant are the hidden flowers, which are not showy at all. After pollination takes place, the stems of these hidden flowers begin to get longer. They grow downward and push their sharp points into the ground. There the young peanuts develop.

About the time the plants begin to turn slightly yellow, the insides of the peanut shells begin to color a little and show darkened veins. The plants are then pulled up and with the peanuts hanging on them are left on the ground until the leaves are slightly wilted. Later they are stacked around poles and allowed to cure for several weeks (Plates 40, 41). When the plants are dry and brittle, the peanuts are picked off. The process of digging and picking is done either by hand or, in these days, by machinery. The peanuts you eat have been cleaned and roasted, although peanuts can be and are eaten raw.

The peanut came in the first place from Brazil. The Incas had grown the plant for centuries—just as they had corn and potatoes —but it came to us by way of Africa via Portuguese exploring ships, then by slave ships. The big development in peanuts did not come about until after the Civil War. By this time we have about 20 varieties—some large, like the Virginia Runner and the Tennessee Red, with four seeds, some small like the Spanish, with two small, nearly round seeds.

Everyone knows how peanuts and peanut butter are used. Less well known are the uses of peanut oil and the peanut meal left after the oil is taken out. Sardines may be packed in peanut oil; it

is used for margarine, as an adulterant for olive oil, in soaps, lubricants, and other things as well. The cake, or peanut meal, is fed to livestock. It is a very valuable feed because it has a high-energy content.

## Peas

People may mean several kinds of plants when they mention peas. There are the chick peas of Europe, which we grow only to a limited extent. There are the garden peas, which we grow on about 400,000 acres in the commercial truck gardens, or in home gardens. Then there are the field peas, grown on about 260,000 acres, which we use for 'split peas' or pea meal (Plate 42). Besides these there are the cowpeas grown for seed or for livestock or fertilizer, principally in the South but also a little in the North, on upwards of 5 million acres. Blackeyed peas, by the way, are neither beans nor peas, but a special kind of legume that resembles beans.

Both the garden pea and the field pea originated in southern Europe, and there is no question but that they have been used by mankind for several centuries. Pea seeds have been found in the remains of the ancient lake dwellings in Switzerland. The garden peas contain more sugar than the field peas do, and we use them as green peas exclusively. The field peas resemble the garden type —they are simply varieties of the same species—but we use them in the dry state. After field peas have been thrashed, the vines are stacked in odoriferous piles to be used for fertilizer. These pea stacks are a common sight in pea-growing country.

The cowpeas are neither peas nor beans, although they are more closely related to beans, which they resemble. They came originally from southeastern Asia, and they have been cultivated by the Chinese since prehistoric times. In the southern States, cowpeas are used to eat, either in the pod, shelled green, or as dried beans. About a fourth of the acreage is grown to eat; the remainder is used for fertilizer or for livestock.

## Legumes for Fertilizer

Besides the legumes we use principally for food there are a great many more that we use for pasturage, hay, or for their fertilizing effect on soil. It is rather difficult to be precise about this, because most legumes may be used several ways. Cowpeas, field beans, and soybeans are human food plants, yet they are important hay crops also and may be used solely for fertilizer.

Fertilizer crops are usually called green manure or cover crops. In speaking of cover crops, farmers mean crops that are sown to provide a cover for soil during the time ordinary crops are not growing on it (Plate 22). Crimson clover, for instance, is planted in cotton fields at the end of the cotton season to keep the soil covered during the winter. Cover crops are of great value in protecting soil from erosion, as we shall see in the last chapter. Here we may note that the cover crops are plowed under just before the next season's crop is to be planted, and that their beneficial effect on the soil is very great.

Since most of the green manure and cover crop plants are also used for hay we may profitably take them up in the chapter on Land for Livestock.

## XI

# TOBACCO

NINE people out of ten are likely to think of the South when tobacco-growing is mentioned. Somehow tobacco, like cotton, has long been associated with great plantations, singing darkies, and other things South. But nine out of ten would be at least partly wrong, because, while more tobacco is grown in the Southeast than elsewhere, a very great deal is grown in the North. Massachusetts grows tobacco; so do Kansas and Indiana; Minnesota grows some, and Wisconsin ordinarily grows more than Maryland does.

For the last 50 years we have been growing more than a million acres of tobacco, and within the last 30 we have now and then raised tobacco on 2 million acres. North Carolina and Kentucky account for 60 per cent of the crop; adding Tennessee, Virginia, South Carolina, and Georgia, these six States produce about 85 per cent of all our tobacco. But there are a great many kinds of tobacco, and there are certain kinds that do better in one part of the country than in another so that the amount produced per State really does not tell the whole story. At any rate, the traveler is likely to encounter tobacco fields in a number of places in the eastern United States, but rarely or never in the West.

### THE EARLY HISTORY

Tobacco is one of the plants given to the world by the Americans. No one knows how long it has been cultivated, but the earliest explorers in North and South America found the Indians of both continents using the plant in one way or another. The Peru-

vians apparently used it medicinally in the form of snuff, but the Aztecs of Mexico used it in pipes or smoked it in the form of cigars. In fact, nearly all the Indian tribes of the two Americas used the plant, and many of them must have had it for many centuries before the Europeans got here. Among some of the tribes at least, tobacco was so highly prized that the men worked at growing it, although women ordinarily cultivated all other crops these tribes had.

The early Spaniards were intrigued by tobacco. They promptly took seeds to various islands in the West Indies, where they began to grow it. They took it also to Spain, where it was grown for a while as an ornamental and for medicinal purposes. Some years later, in 1560, the French ambassador to Portugal took the plant to France. The ambassador's name was Jean Nicot, and it is his name that was used to give the scientific name *Nicotiana* to tobacco. Nicotine, the poisonous alkaloid found in the plant, also gets its name from Jean Nicot.

Up to the time tobacco got its scientific name it was simply called *tobaco*, which is what the Spaniards thought the Indians were saying when they referred to the plant itself. As it turned out, however, the Indians didn't mean what the Spaniards thought they did. The Indians were talking about a tube or a pipe of a primitive sort that they used for smoking the prepared tobacco. Like many other words the Indians gave us, the name tobacco has been misapplied, but it has stuck just the same.

There is some confusion about the different species of tobacco included in the early beginnings of its use by Europeans. Altogether there are some 50 species of *Nicotiana*, but only 2 are important as sources of tobacco. One of these is the species that the Spaniards found in Central and South America. The other is the one the Indians of eastern North America were growing. This North American species was taken up by the earliest tobacco-

growers in Virginia, and it was also the first grown in England. Very soon, however, the tropical American species seems to have replaced the North American kind, and it has now become the really important type.

Tobacco played a very important role in the development of many southern States. In Virginia especially, tobacco-growing is declared to have been the backbone of the colony. It was one crop that the colonists were able to use in trading with England. At one time it was used as money, and in 1732 Maryland made it legal tender. Salaries of clergymen and State officers were actually paid in tobacco at the rate of a penny a pound.

Tobacco spread rapidly over the world. About 5 billion pounds of it are grown every year. The United States produces the most, India is a close second, and these two countries together account for a little over half the world's crop. By this time over a hundred different varieties are known, and tobacco-growing is a very highly specialized business.

## Growing Tobacco

If you were patient enough to try counting them, you would find that it takes more than 6 million tobacco seeds to weigh a pound. The seeds are as fine and dust-like as those of petunias (to which tobacco is related), and they must be carefully handled. All through the tobacco country you will run across tobacco seed beds, where the seeds are sown and the young plants started—all very carefully indeed. It takes only about a level teaspoonful of seed to sow a hundred square feet of bed.

After the young plants are strong enough to take care of themselves, they are planted out in rows in the fields (Plate 43). Over and over again the plants are cultivated until they get so big that they are bruised by the cultivator. The tops of the plants are later broken off to force the development of large leaves.

As soon as the leaves are ripe, the tobacco is harvested, either by cutting off the individual leaves or by cutting the whole stalk. In either case, the tobacco is hung on a lath and taken into curing barns. There the leaves or plants are hung on racks and dried (Plate 43). Some kinds are simply air-dried in well-ventilated barns; some are dried over charcoal fires; and some are dried by hot air. The three ways of drying or curing result in air-cured, fire-cured, and flue-cured tobacco respectively. The drying process is slow and the leaves ferment slightly, dry, and turn yellow-brown to dark brown. With some tobaccos the leaves are stacked after curing and allowed to ferment for an additional time to develop aroma and bouquet.

In tobacco country, the barns are always in evidence. Where the tobacco is fire-cured or flue-cured—which also requires fire to heat the air—someone is always setting fire accidentally to barn, tobacco, and all. In the South the occasional lonely chimney standing by itself like a monument is all that remains of a tobacco shed that burned when the fire got out of hand. There are many hundreds of them by this time, and they are a familiar sight.

## Tobacco Geography

Early in this chapter we hinted at the fact that tobaccos for different uses are grown in different places. A variety grown in one place on certain kinds of soil may be a very different tobacco when it is grown somewhere else. Quite often there is a difference between the product of one field and that of a neighboring field, even though the variety and treatment are exactly the same. This is all very embarrassing to the botanists, who must confess that as yet they do not know how to account for these differences. But the tobacco experts know that there are such differences and they take full advantage of them.

Tobacco for cigar wrappers is commonly grown under artificial

shade. In the tobacco country of Massachusetts and Connecticut you may see hundreds of acres covered with cheesecloth on frames (Plate 44). Grown under shade, the leaf is of high quality and commands a high price. Growing shade tobacco is expensive and takes a good deal of skill, but the profits are ordinarily high. Some shade tobacco is also grown in Florida.

In eastern Kentucky and Tennessee and north-central Virginia a great deal of tobacco is grown for chewing tobacco and for export to other countries. Cigarette and pipe tobaccos of the flue-cured and Burley types are grown largely from Maryland south to Florida. Tobaccos for cigar fillers—the inside of a cigar—are grown in Pennsylvania and Ohio. Snuff tobaccos come from central Virginia and western Kentucky and Tennessee.

There is a great deal more to tobacco geography than this, but it will serve to show how the relation between varieties and soils and climates has become important. Connoisseurs of fine tobaccos can name you the localities, and in each place the tobacco product results from a combination of climate, soil, culture, curing, variety, and quite a host of other things.

Tobacco is used for other things than for cigarettes, cigars, pipe-smoking, plugs, and snuff. Low-grade types are used to make nicotine-sulfate or 'Black-Leaf 40,' a valued insect spray. They are also used extensively in the preparation of disinfectants and to make other nicotine products. Stalks, stems, and by-products of the nicotine industry go to make fertilizers.

## Better Tobaccos

Plant breeders are frankly embarrassed about tobacco. It is one thing to breed corn that yields more grain, or to breed bigger roses, or cotton with longer fibres. But how are you going to breed tobacco for aroma? Or bouquet? Or fine quality? Or better flavor? —When all these things depend as much on soils and fertilizers

and curing as on the variety of tobacco? The very things that tobacco experts look for are too subtle to get under control. Furthermore, when the plant breeders start trying to breed tobaccos resistant to diseases—which they *can* do—they may lose all the aroma or flavor, and the new variety is no good even though entirely healthy. In the 1936 *Yearbook of Agriculture*, Garner, Allard, and Clayton have this confession to make:

Plant breeding has accomplished a great many extraordinary things, but in all modesty the tobacco breeder must confess at the outset that he is somewhat baffled by the old problem of how to give America a good 5-cent cigar.

The first difficulty is the fact that the thing of greatest importance in tobacco is quality. This is true to a considerable extent for other plant crops also, but with very few crops is quality as all important as it is in the case of tobacco.

The finer elements in the quality of tobacco cannot be measured. They depend mainly on two things—flavor and aroma. There are only two known devices capable of testing flavor and aroma, and they are not machines—the palate and the nose. This is the reason why, when so much else has been reduced to a mechanical basis, we still have to have coffee tasters, tea tasters, butter tasters, cheese tasters, and perfume experts. And even these are few and far between. They are born, not made.

In other words, these elements in the quality of tobacco are extraordinarily subtle. Not only can they not be measured as yet; by the same token they are not under the control of the plant breeder. Since he has no notion what factors are responsible for these qualities, he cannot breed for them.

However, these writers go on to discuss the steps that are being taken. Varieties more resistant to serious diseases of the tobacco are being developed. So are strains that contain less of the habit-forming nicotine. And so are types with larger leaves as well as greater numbers of leaves per plant.

In the meantime this country is producing upwards of 180 bil-

lion cigarettes and 5 billion cigars, to say nothing of 200 million pounds of pipe tobacco, 37 million pounds of snuff, and some 60 million pounds of chewing tobacco. The value of the industry is obviously enormous.

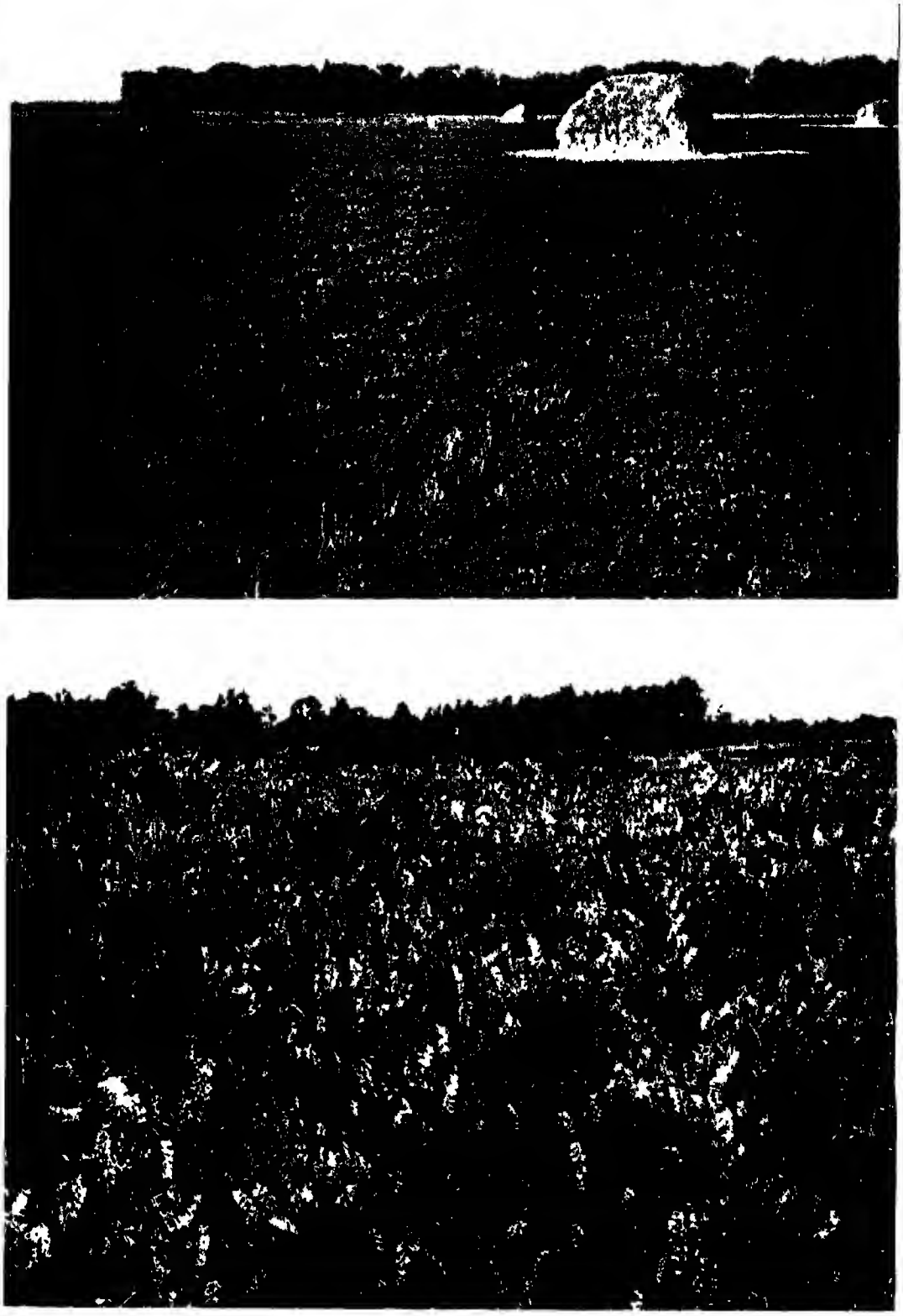

PLATE 45. Alfalfa and alfalfa hay on a field in North Dakota. Background trees are in a planted windbreak.

BOTTOM. A field of vetch in flower. Wheat is planted with it and the mixture cut for hay.

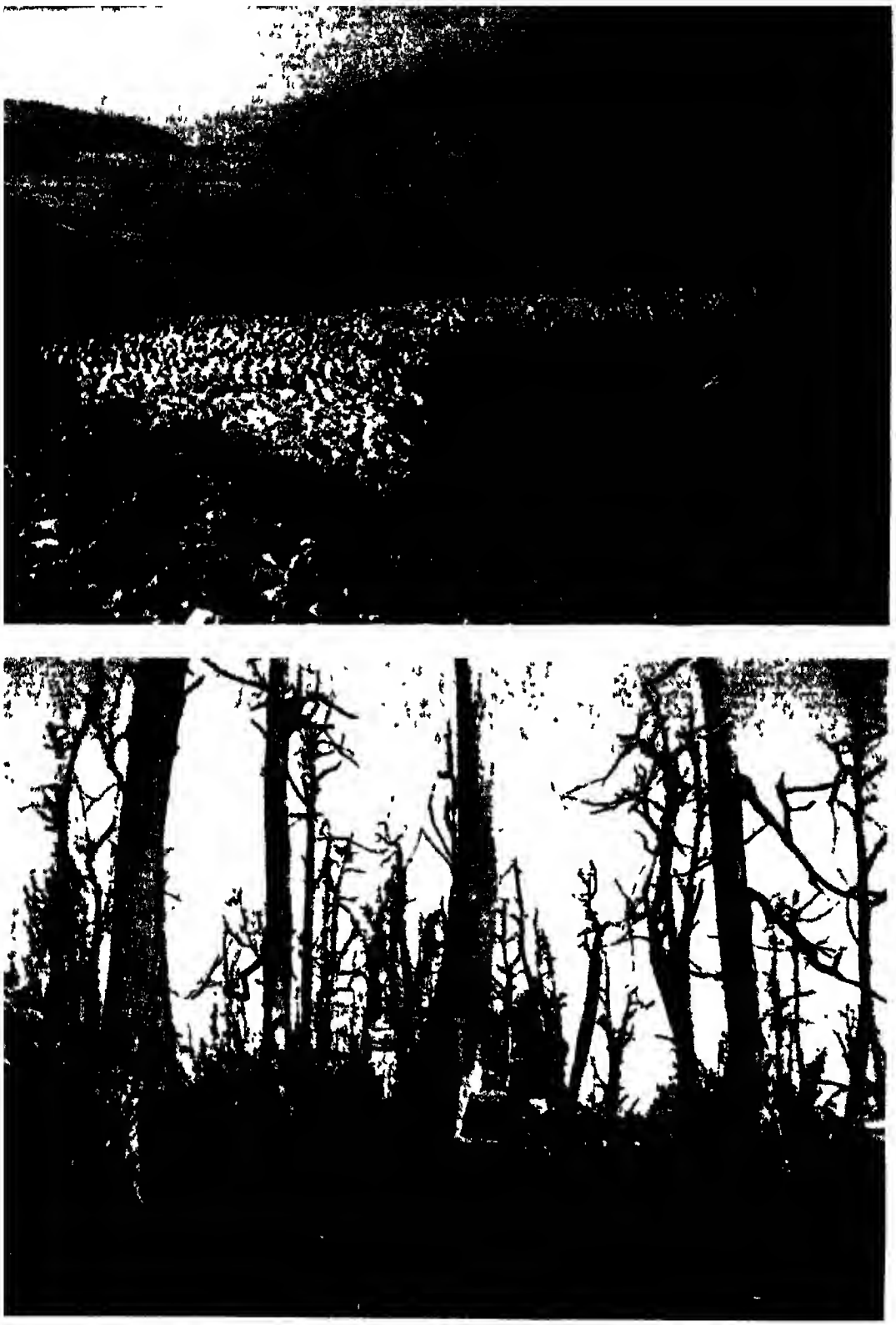

PLATE 48. Rangeland in Utah. Herders with dogs handle the sheep, eat at the chuckwagon. BOTTOM. American chestnuts, destroyed by blight, stand as skeletons in the Appalachians. Young sprouts will die after a few years.

## XII

# LAND FOR LIVESTOCK

ANYONE who stops to think about it knows that an animal can get hungry, but only those people who live on farms realize what a whale of a lot of land it takes to grow enough food for the lusty appetites of all our domestic livestock. Besides 70 million head of cattle to feed, there are 10 million horses and 4 million mules. There are 700 million chickens and 20 million ducks and geese to think about, to say nothing of 30 million turkeys; and somebody has to feed 55 million sheep, as many pigs, and about 4 million goats. Every year enough food to satisfy these vegetarians has to be produced somewhere, and every year the farmers manage to do it. Compared with this gigantic task, the feeding of an army seems trifling.

It is rather difficult to marshal all the figures to express the amount of land used to grow food for livestock. In earlier chapters we have had much to say about various crop by-products that are used to feed cattle or sheep or poultry. The bagasse from sugar cane, the cake from cotton-seed oil, the residue from tomato juice manufacturing—such things as these entitle us to consider the land on which we grow many crops as devoted partly to livestock food. The land on which we grow grains is certainly in great part land for livestock; most oats, for instance, are used for livestock feed, as is probably 85 per cent of the corn we grow. Vast acreages of land for general crops are grazed over by livestock after the crop has been harvested. Certainly if we added all these types

of land together, the total would be most impressive. But this is only the beginning.

Besides the land in which livestock may be said to have a partial share, well over a billion acres in the United States are used solely for livestock and nothing else. Land in pasture, the land used for hay, and the vast range lands of the West make up this impressive total. And if by chance you are not impressed, note that there are, after all, only 1,903,000,000 acres of land altogether in this country, which means that more than half of our total land area is in hay, pasture, and range.

Almost a billion acres is accounted for by pasture and range alone; in this vast amount, 70 million acres of hay land almost disappears, so to speak. Yet for all their tremendous area, pasture and range lands actually produce only about half the cattle feed we need; the rest is grown on crop lands.

## The Land in Hay

Although a great many people think of hay as dried grass of some kind, and although to be sure, perhaps as much as a third of all the hay we grow is grass hay, all the rest—and most—is made from clover, alfalfa, lespedeza, soybeans, cowpeas, and related plants—all of them legumes. You may recall noticing earlier (in Chapter 10) that legumes are rich in protein, and because of this they have a high feeding value for livestock.

But no matter what kinds of plants are cut for hay, the job of making hay is not one for a beginner to tackle. It takes judgment and experience to decide just when the hay plants are ready to be cut—not too green, not too old and woody, but just exactly right. And it takes experience to decide when the hay is properly cured, whether it is dry enough to stack, or whether it should stay another day in the swath, where it lies after being mowed.

Sweet hay with good color and well cured is what you want, and what you get—if you know how.

At any rate, all the hay we cut in this country is either wild or tame. The grasses and sedges of the great marshes along the Atlantic Coast are of the wild type; so are the native grasses of the prairie States. It was these wild grasses that early settlers depended on for livestock feed, and because the grasses were abundant, the pioneers could take their stock along as they pushed westward. Native hay is still very important in the northern Plains, for instance, and some of it commands a high price. Other places native hay is pretty poor stuff. All told, we harvest wild hay from 11 million acres each year, but the yield is low and we rarely get more than 8 or 10 million tons. Generally speaking, wild hay is becoming less and less important as we increase our acreage of the tame product.

Tame hay is to be seen almost anywhere in the country, and on the 60 million acres we use for growing it, we pile up about 80 million tons a year. The heavy production is in the Northeast, the Corn Belt, and in the irrigated valleys of the West, but a short drive in any direction from nearly any point in the country, outside of the extremely arid Southwest, is likely to reveal a hay meadow.

Aristocrat of all our tame hays is alfalfa, or, as the Europeans call it, lucerne. Alfalfa means 'best fodder' in Arabic, and in the United States this legume from southwestern Asia lives up to its name. We produce a heavier tonnage of it than of any other kind of hay, and it leads all the rest in the number of animals it will support per ton. From the roadside a field of alfalfa usually appears darker green than any other kind of hay crop we grow. Lush green, one might call it, thick-growing, and bearing at its maturity a sprinkling of light purple flowers (Plate 45). Known to civilization for more than 2,000 years, alfalfa continues to increase in im-

portance in this country. Twenty years ago we grew nine million acres of it; today we grow fourteen million, and there seems no doubt that in the future we will expand this amount considerably.

Standard among the tame grass hays is sweet-smelling timothy hay derived from the grass Timothy Hansen introduced into Maryland in 1720. Native to Europe, it was never cultivated until it was brought to the United States, where we now grow it on some 11 million acres. Nearly all of it is to be found in the northeastern quarter of the country or in cooler places of the West. Very commonly it is grown with clover, and it is acknowledged to be the finest hay of all for feeding horses.

Clovers of a great many kinds are themselves used so much for hay that they can also be classed among the top-ranking plants for this purpose. Red clover and white clover, alsike clover and crimson clover are all known as true clovers. Besides these there are the sweetclovers with yellow or white flowers, bur clovers that are more closely related to alfalfa, and Japan clover, more properly called lespedeza. Foreigners all, these various clovers have come to us from Europe or Asia and are used for hay, for pasture, or for the green manure such legumes produce so well.

There are many others. We use grasses and legumes of a number of kinds—bromes, fescues, rye, bluegrass, and reed canary, cowpeas, field peas, soybeans, vetch, and peanut vines (Plate 45). In the South we now use Bermuda grass and Johnson grass for hay as well as pastures, although we formerly believed both these species were noxious weeds and fought their spread for years. Many new species are appearing that hold promise of making fine hay. Among them are crotalaria or rattlebox, lupines, velvet-beans, sericea lespedeza, and kudzu, a gigantic vine from east Asia that is performing such miracles on the worn soils of the South (Plate 46).

But legume or grass, making hay while the sun shines is still as

important as ever for both. Hay must dry quickly so that it does not get musty or discolored; hence making hay in wet climates has its difficulties. Once dried, it goes to the barn for storage, either loose or in bales, or it may be stacked in the open. Some places farmers use poles in the center of their haystacks; other places the stacks are without poles, and they may take all sorts of shapes. It has been said that an expert can tell the part of the country he is in by looking at the shape of the haystacks, and while this is not altogether true, it is interesting to try (Plate 44).

## Pasture Land

One of these days, experts hope, all farmers will be as careful about pastures as they are about corn or wheat crops, and when that time comes, the problem of feeding livestock is going to be decidedly simpler than it is now. The trouble is that most American farmers have yet to learn how to make their pastures really pay dividends. European pastures outproduce our best ones two to one, and so they are likely to continue to do until a lot more farmers mend their ways.

Even a layman can spot a poor grass pasture. It is usually full of a miscellaneous assortment of weeds that should have been mowed. It often contains a good deal of brush, and in extreme cases the brush is browsed into bizarre hour-glass or cone-like shapes by hungry cattle. In some places the grass is nibbled into the ground, in others it has gone to seed and is too tough for cattle to eat. In fact, poor pastures usually look like abandoned land, which is just about what they are.

Good grass pastures, like fine lawns, are pearls of great price. The rich green grass is uniformly grazed, there are few weeds, no brush, no rocks, and perhaps a tree or two for shade. But like a beautiful lawn, they get that way because of careful fertilizing, mowing, and other kinds of attention (Plate 46). Lush grass pas-

tures do not have so many animals on them that the grass is ruined by overgrazing, or so few that the grass goes to seed and gets tough. A little study, even from the roadside, will enable anyone to distinguish between the neglected pastures with their poor animals, and the fine, rich, improved pastures that support sleek, fat livestock.

There are other kinds of pastures than those composed of grass. Well-developed clover pastures are to be seen in some places (Plate 47), and lush growths of sweetclover also make fine pasturage. A detailed account might take up bluegrass pastures, Bermuda grass, carpet grass, lespedeza, bent, rye, and brome-grass pastures. We could go on to point out that hay meadows are pastures also, in the sense that they are often grazed after the hay is cut. So too are fields of young grain pastured for a time in fall and winter. But of pasture intended for permanent use we have some 230 million acres, and of all that great area we can boast of only 60 million acres of pastures that are good enough to be half as good as those produced in Europe.

Our best pastures are to be found principally in the States north of the Cotton Belt in the East, and in the coastal regions of the westernmost States. The pastures of the South are largely unimproved although they are getting better every year. The pastures of the arid West are ordinarily not called pastures at all, but range land. At any rate, the chances are good that wherever you see pastures you will see poor ones and good ones in the ratio of three or four to one.

## Range Land

In the western half of the United States is to be found the enormous area of arid pasture that is known as the western range (Plate 47). Altogether it amounts to 728 million acres, which is nearly 40 per cent of the total land surface of the United States. Its appearance is by no means uniform, but all the various kinds

of land that compose it have one character in common, namely, their use as grazing land for livestock.

This great mass of land begins just about the middle of the United States. If you were to draw a line from Canada to Mexico that would cut the Dakotas in two, cut off the panhandle of Oklahoma and end at the southern point of Texas, you would have indicated fairly well the eastern edge of the range country. Within the territory west of that line about three-quarters of the land is livestock range. This does not mean, of course, that out of every four acres three will be in range. There are very large areas in the West that are not range at all, just as there are enormous areas that are nothing but range.

If you live in the East, you should by all means rid yourself of the idea that 'range' means a level, grassy plain extending as far as the eye can see, because it doesn't (Plate 48). About half the range is true grassland, fairly level, and with few or no trees or shrubs in sight, but the other half has some kind of woody vegetation on it. A great deal of the range is rocky and mountainous and its vegetation varies all the way from the magnificent firs and spruces of the high mountains, to sagebrush and the desert scrub of the Southwest. At favorable seasons the range is green, but most of the summer on most of the range, the aspect of the country is gray and brown, dry, and like anything but the lush green pastures of the more humid East. You may not have realized it perhaps, but about 60 per cent of the land in our National Forests, for example, is used for grazing livestock. All kinds of land, whether principally in forest, chaparral, sagebrush, desert shrubs, or tall or short grass, can be and is used to supply pasturage for cattle, horses, sheep, and goats.

It is worth noticing that livestock use shrubs and trees also for food. Browsing, the Westerners call it, and it accounts for the pruned and mangled appearance of sagebrush and other shrubs

over great areas, as well as for the 'browse line' on trees. Some shrubs are fine browse, others are very low in food value and animals rarely touch them unless they are very hungry indeed. Grass, of course, is to be preferred; really good grass is much better feed than the general run of browse.

If the great western range were in good condition—which it is not—it could support at least 22 million head of cattle. Actually, because it has been terribly misused, it can safely carry no more than 11 million. There is only half as much forage, in other words, as there used to be. But note this: even though the range cannot stand it, it has the equivalent of 17 million head of cattle on it. That is what people are talking about when they say the range is overgrazed.

The seriousness of overgrazing on the western range varies from place to place, even from year to year, yet for the last three decades the general condition of this vast area has been getting steadily worse. Not much more than 5 per cent of the entire range area is in what range experts call a satisfactory condition. By this they mean that because there are too many animals grazing on the range, the forage is being gradually 'grazed into the ground.' As this vicious process goes on, year after year, the plant cover eventually gets pretty thin. The grasses get fewer and farther between, worthless weeds begin to come in, erosion takes a heavy toll, and people in the cattle business go broke. In some places in the West, cattlemen remark grimly that cattle have to travel on a dead run to get enough to eat, the grass is so thinly scattered.

How much grazing an animal can get from different kinds of pasturage varies a great deal. The pastures in the humid East can support many more cattle than the arid range of the West. An acre of really good eastern pasture can support 2 or 3 cows for the summer. On good grass range it takes 2 to 3 acres to support 1 cow for a month, and on poor range it may take from 10 to 20

acres. The number of animals per acre that land can support is spoken of as the carrying capacity—and the carrying capacity of the western range was not only low, relatively speaking, to start with, but is declining all the time.

As with pasture, you do not need to be an expert to pick out seriously depleted range. There will be little grass to be seen, except for a few tufts hugging rocks or existing close to a badly mangled shrub. If the land is in sagebrush, the shrubs will be eaten down to the heavier branches. If the land is in trees, all the lower foliage of the trees will be eaten off as high as the cattle can reach, so that a 'browse line' can be seen 4 or 5 feet above the ground. The soil will be dusty, hard-packed and trampled, and any cattle in sight are likely to have their ribs showing.

As you travel over the western range you may notice in the summer that sheep and cattle are rarely to be seen in the low country. This is because the animals are in the high mountains, grazing in the forests or the mountain meadows. As the weather gets cool, they begin to come back down to spend the winter on the lowland range, or winter range. If the winter range doesn't have enough forage, stockmen have to feed the animals hay or some other kind of feed raised on cultivated land. In the spring the animals begin to move up again, to their summer range.

This annual movement up and down is the same for wild grazing animals. Elk and deer, for instance, go from lowlands to highlands and back again each year in pursuit of the best browse or grass. In the West the National Forests are pretty largely confined to high mountains, hence deer and elk are found in them in the summer. In the winter the big-game animals travel to the lowlands. And since the lowlands may not be owned by the Government, the game moves in on private land for their winter range. There is a very serious problem in this annual movement of game. Private ranchers claim the game animals compete with their live-

stock and that there isn't enough food for both. If the Government wants the game in its forests, they say, let it take care of them in the winter time too. The Government says it would like to buy some of the lowland, but the cattlemen say nothing doing; they want to raise livestock on it. The necessary adjustments have been the cause of much argument and endless bickering, and the question is by no means settled yet.

There are very many more difficult problems connected with the western range. The land is generally apportioned in sections, containing 640 acres each, and people usually speak of owning so many sections, rather than acres, as in the East. Because the land can produce so little, it does not pay on most range land to put up fences. Yet, the pattern of ownership is like a crazy-quilt. Land owned by dozens of public or private agencies makes a checkerboard out of the maps of western States. The railroads own land, a dozen Federal agencies administer this or that section, schools own a section here and there, various State agencies own their sections, private individuals own some, and renting of sections from one agency or individual to another is common. All the sections of land owned by a various assortment of public and private agencies and individuals are mixed up in an amazing manner. For this reason any broad-scale, sensible plan of handling range land is likely to founder before it is well started, because too many people and agencies must agree before anything can be done.

Estimates by experts indicate that it may take 50 years of careful management to get the western range in good enough shape even to carry the 17 million units of livestock now on it. Within 50 more years, the range could be put back in its original shape. Range recovery is very slow. The climate is too dry for plants to grow very fast, and where grass or other forage plants have been nearly or quite exterminated, reseeding them is very difficult in such an arid, infertile land.

What all this adds up to is that the western range, although it is exceedingly important, and although we know how to rehabilitate it so as to make it twice as useful as it now is, nevertheless continues to go to pieces. There is a most important book called *The Western Range*, which tells the whole complex, but fascinating story. It was published in 1936 and is a 620-page Senate document (No. 199) that was called for by Congress to assist the legislative body in meeting the range problem. The report is well worth reading. If you do read it and are really interested, get also *If And When It Rains*, published by the American National Live Stock Association in 1938 and consisting of 60 pages. The Association disagrees seriously with *The Western Range*, but it has a point of view you may want to study. Between the two, a layman can get an excellent idea of the whole problem of the great western range.

## XIII

# FORESTS AND WOODLANDS

If any one thing was clear about American land in the beginning, it was that the great forests covering it were an infernal nuisance. You could never get a patch of ground for crops unless you disposed of the trees first, and there, stretching away in all directions, was a veritable jungle that provided a fine place for Indians to hide in. There were, to be sure, some good clearings the Indians had made that could be had for a string of beads, but these were soon taken up. Perhaps, after all, it was a good thing for the peace of mind of those earliest settlers that they had no notion of how much forest there was to be cleared. Had they known that the land from the Atlantic shores to the Plains (of which they had not the remotest idea) was just about entirely covered with trees, perhaps their hardy pioneering spirit might have been dampened a little. Had they known, in fact, that almost half of America was heavily forested, who knows but that they might well have sailed back to England?

But many decades have passed since the time when trees were still thought of as liabilities rather than assets. Forests and woodlands are highly prized now for a variety of reasons few people foresaw centuries ago. During settlement days the markets for timber and wood products were tiny compared to present markets. The colonies shipped lumber, pitch, and rosin to England, but in very small quantity compared to that produced in more recent years. The demand for wood pulp to make paper was non-existent until about 1850. Rayon made from wood pulp had not been

dreamed of much before the beginning of the century we live in. And, until there were enough people in America to need large quantities of the things we get from trees, there was no home market to speak of. Little wonder that wood was a drug on the market, in view of the gigantic supply and the relatively small need.

Gradually, as America grew, trees became more and more valuable, until there came the time when land was acquired not for itself but for the forests it supported. Tied up with the history of public land sales there is a story of forest exploitation without parallel in history that we have not the space to consider here. Suffice it to say that it was the long period of wasteful extravagance that finally forced America to adopt a policy of conservation with respect to its forests. The protests were loud and long from private interests making the most money out of timber, but exploiters ran out of forests they could exploit along about the beginning of the present century, as people began to see what it was leading to, and as the Government began to bear down on profiteers.

This century has been different. There is still a good deal of unwise and wasteful use of forests, but there is less of it by far than there used to be. Excepting the fools and criminals we have always with us, Americans as a whole are interested in seeing that American forests and woodlands are used wisely so that we may get all we can from them without destroying them.

## The Size of the Forest

To make an accurate estimate of the amount of land that used to be in forest is a pretty difficult job because things have changed so. But there is such an estimate in existence, tucked away in the *Atlas of American Agriculture*. In the final pages of that mighty tome there is a section on the original vegetation of the United

States, written by Homer L. Shantz and Raphael Zon. Those two great scientists, after many years of study, finally arrived at the following figures:

| | |
|---|---|
| Of forest | 48 per cent, or about 913 million acres |
| Of grassland | 38 per cent, or about 723 million acres |
| Of desert shrub | 14 per cent, or about 266 million acres |

The amount of country in desert shrub is still about the same, even though the shrubs have been pretty well chewed by grazing livestock. The grassland still existing in virgin condition is mostly to be found in small remnants. Of the original virgin forest, about 100 million acres are left, which is about 11 per cent of what there used to be.

Altogether, about 40 per cent of the land that had forest on it in the beginning has been cleared to make way for farms. The other 60 per cent is still left, even though a great deal of the forest on it may have been badly mauled in the meantime. There are, in other words, still 625 million acres of land in the United States that we say are in 'forest.' We do not mean exactly that, however, because there is a good bit of 'forested' land that is pretty sorry stuff, either because it has been cut or burned over, or because that's the way the trees grow.

To get a good idea of just what we have there is nothing for it but to look at a few figures, such as these:

| | |
|---|---|
| Commercial forest land | 495 million acres |
| Land with good timber that cannot be used, as in parks | 11 million acres |
| Land in poor, scrubby forest | 119 million acres |

But before you are carried away by the size of the 495 million acres in commercial forest land, it will pay to look at that figure a little more closely, thus:

| | |
|---|---|
| Land with good saw-timber on it | 189 million acres |
| Land with small timber good enough for fuel or pulp, or ties | 121 million acres |
| Land with good stands of young trees | 102 million acres |
| Land with poor stands of young trees | 83 million acres |
| Total | 495 million acres |

Each year more good saw-timber becomes ripe for the cutting, but we cut almost twice as much as becomes ready. We lose about 40 million acres a year besides in forest fires. And what this all amounts to is that even though we still have splendid forest reserves of forest, the speed at which we are using them is about twice as great as the speed with which the forest is renewing itself. At the ratio of almost two to one, the forests cannot last forever. One of these days, unless things change, we are going to run out of timber to cut.

Our present-day forest has about a third as much saw-timber in it as there was in the original American forest. About three-fourths of our forest land is in the eastern United States, but by far the most of this is second-growth. The cream of the timber crop is in the West; in fact, four-fifths of the saw-timber and nine-tenths of the remaining virgin forest lies west of the Great Plains. This general distribution of forest is well known to anyone who has ever traveled from coast to coast.

In passing it may be worth noting that a little over half our commercial forest land belongs to lumbermen, paper companies, mining companies, railroads, or other private concerns. The Federal Government owns about a fifth of it, and the farmers own all the rest except some 10 million acres belonging to states, counties, or towns.

## The Kinds of Trees

There are about 800 different kinds of trees in the forests of the United States, which is one reason why this book cannot treat them all, except in a general way. By far the most of the species are called broadleaf trees, to distinguish them from the conifers, which have needle-shaped leaves. Broadleaf trees include those such as hickories, maples, oaks, elms, and the like, while conifers include species of pines, firs, spruces, hemlocks, cedars, and others, nearly all of which bear their seeds in cones (coni-fer = cone-bearing). To gain a rough idea where the various kinds are to be found, it will pay us to make a quick survey, starting in the West and finishing in the East. We should remember as we do this that the 'important' trees are, for the most part, the kinds that produce most timber, and that more species are not mentioned than are discussed.

*Pacific Coast Forests.* On the West Coast, from the Canadian boundary to southern California there are some 66 million acres of land in conifer forest containing about half of all the saw-timber in the country. There are few forests in the world that are the equal in magnificence of this great western stand (Frontispiece and Plate 49). In density and size of the trees, the Pacific forest has few, if any, peers. Much of it, as we noticed earlier, is still in virgin condition. And it is from this great forest area that we get each year fully two-fifths of all the lumber produced in the United States. This is the location of the largest lumbering operations in the country.

Most important of the trees in this region is the great Douglas fir, so-named in honor of that hardy Scotch plantsman David Douglas. This tree produces excellent lumber for heavy construction, and because it is so tall and its first branches are so high up, it is often used for flag-poles, spars, and masts. Douglas fir is found

PLATE 49. Virgin forest in Washington typical of north Pacific forest. Center tree is Douglas fir, others are western red cedar and hemlock.

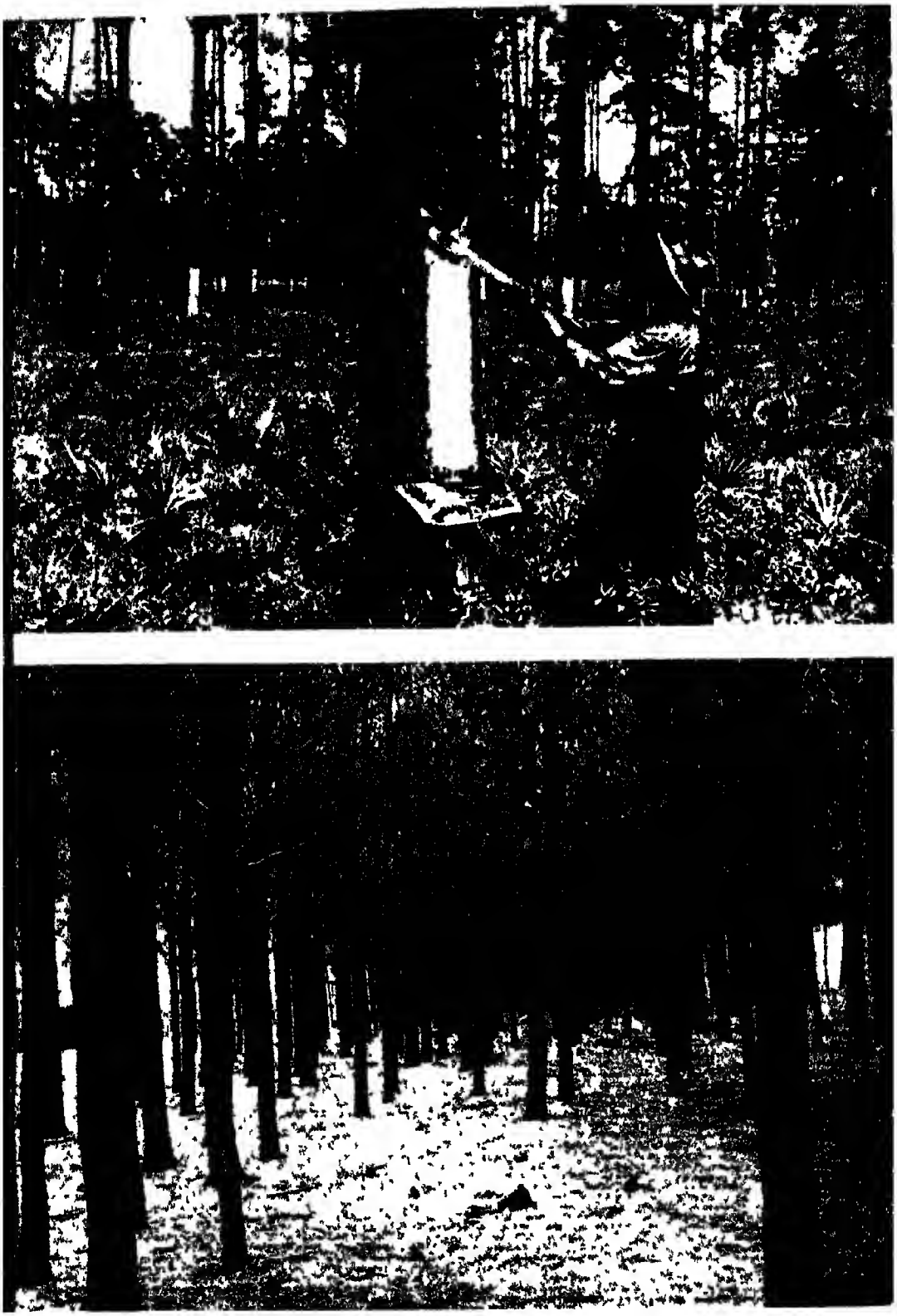

PLATE 50. Cutting southern pine in Georgia to obtain pitch from which turpentine and rosin are made.

BOTTOM. White pine plantation of the old style. Foresters of the new school plant mixtures

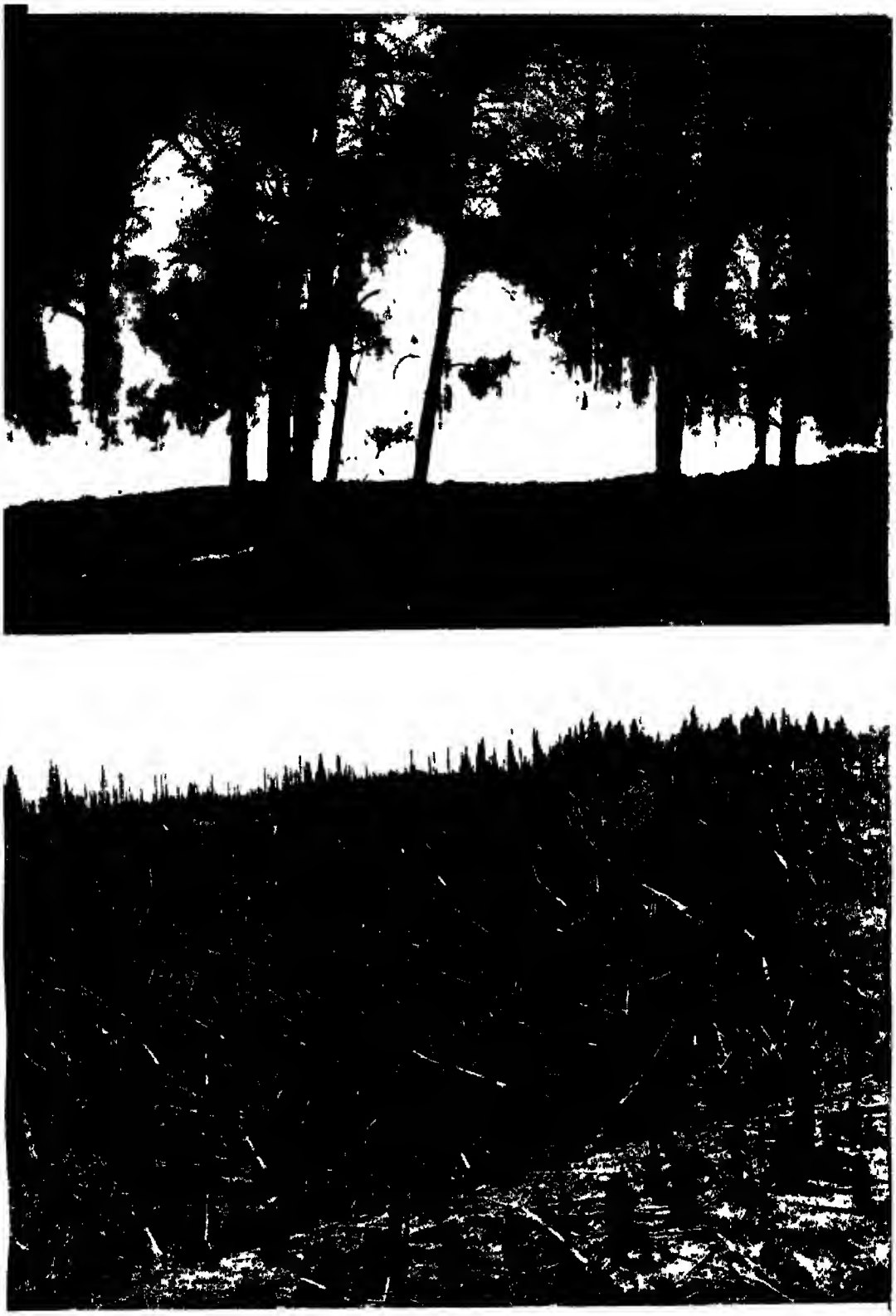

PLATE 51. Uncontrolled burning of southern forests to provide livestock pasture ruins forest for sustained production of timber products and provides poor pasture at best.

BOTTOM. Fire plays havoc with forests. This western burn has a scattering of young trees that will replace the old forest after many years.

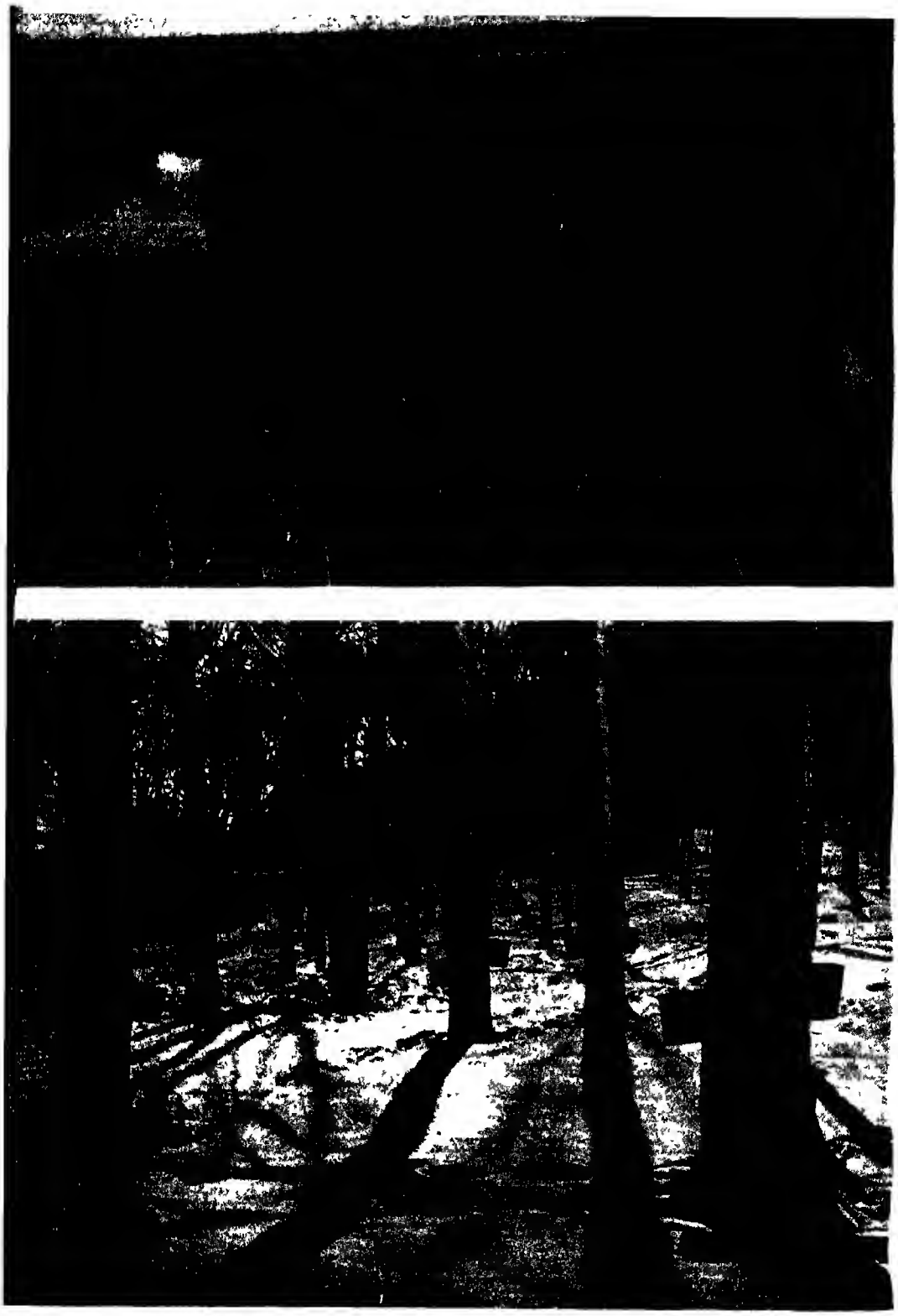

*Plate 52. Land of this type is commonly used for waterfowl refuges. The sedges and rushes make excellent nesting cover.*

BOTTOM. Sugar maples tapped for sap in a Pennsylvania 'sugar bush.' In large-scale opera-

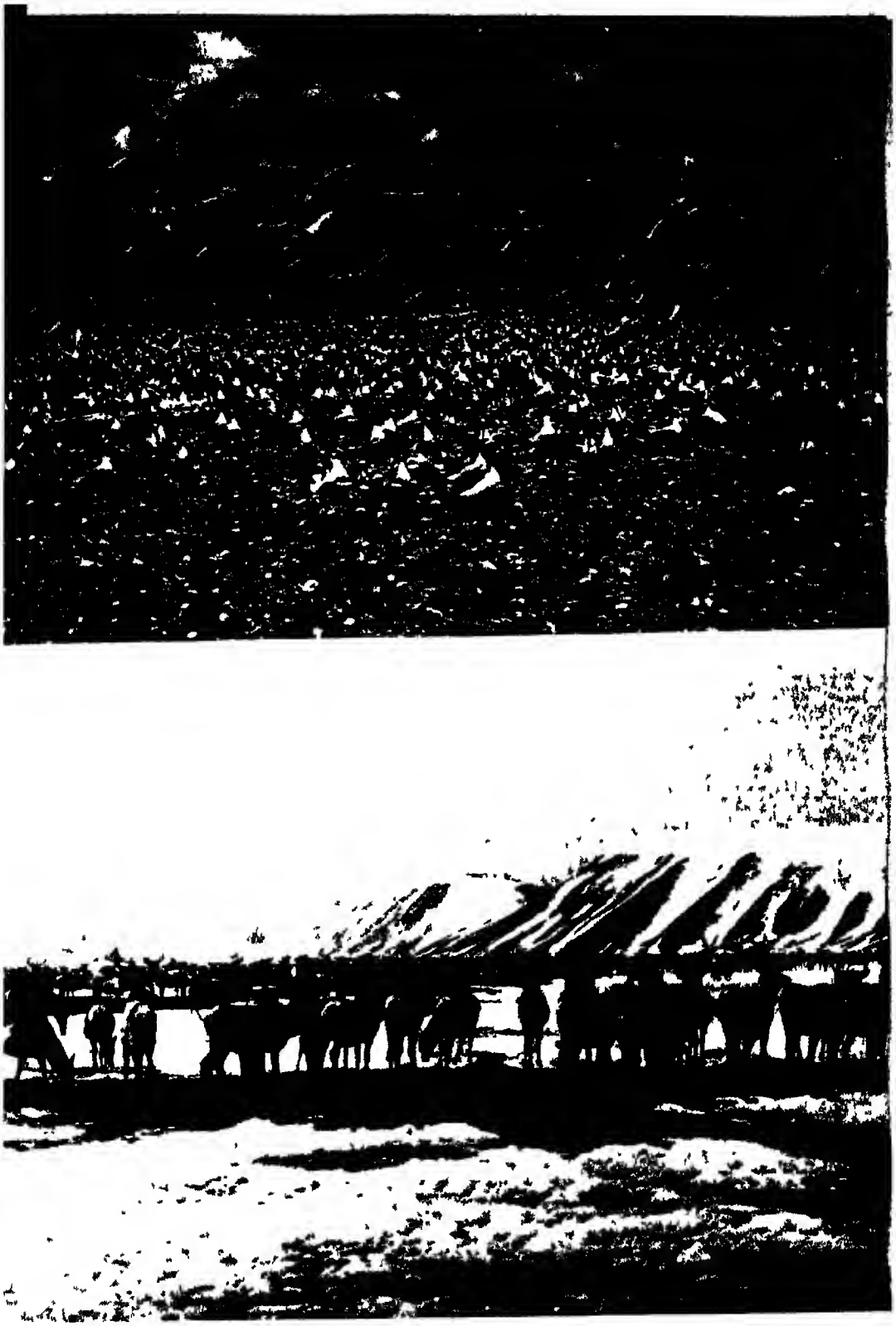

PLATE 53. Coastal refuge area in North Carolina. The birds are royal terns, which lay eggs on the rocky ground.

BOTTOM. Elk on winter feeding ground of a refuge in Wyoming.

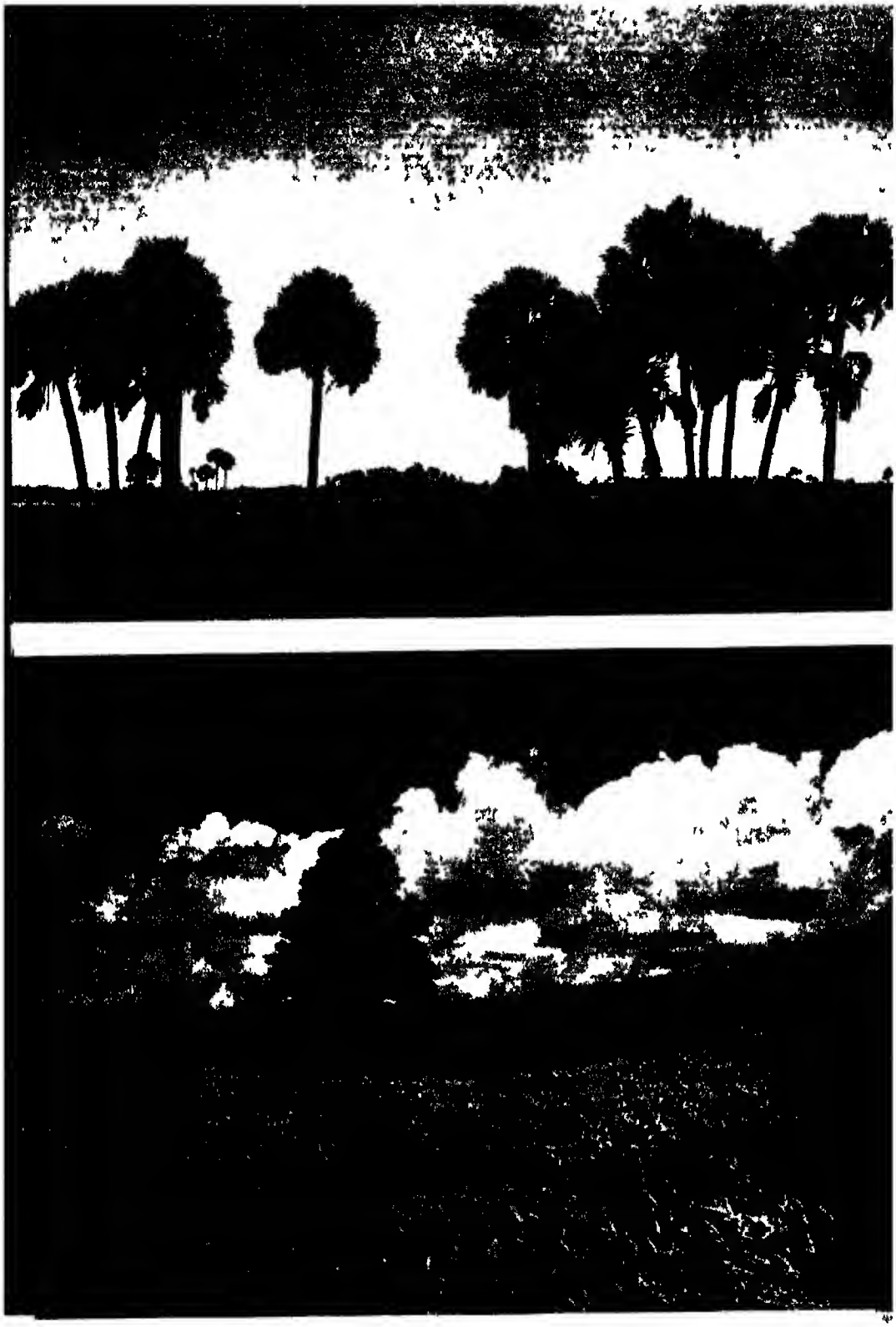

PLATE 54. Palm hammocks in the proposed Everglades National Park of Florida.
BOTTOM. Typical bit of wildlife land in agricultural land. Too steep to use for crops, such areas are best protected to serve as habitats for game, fur, and insect-eating animals.

over a great deal of the Pacific Coast region, and in northwestern Oregon and Washington is particularly abundant.

In this same section of country, in California and Oregon, there grows the famous redwood, one of the two largest trees in the world. The wood is smoky red in color, strong, but very soft, light, and very durable. We use it to make shingles, water tanks, posts,

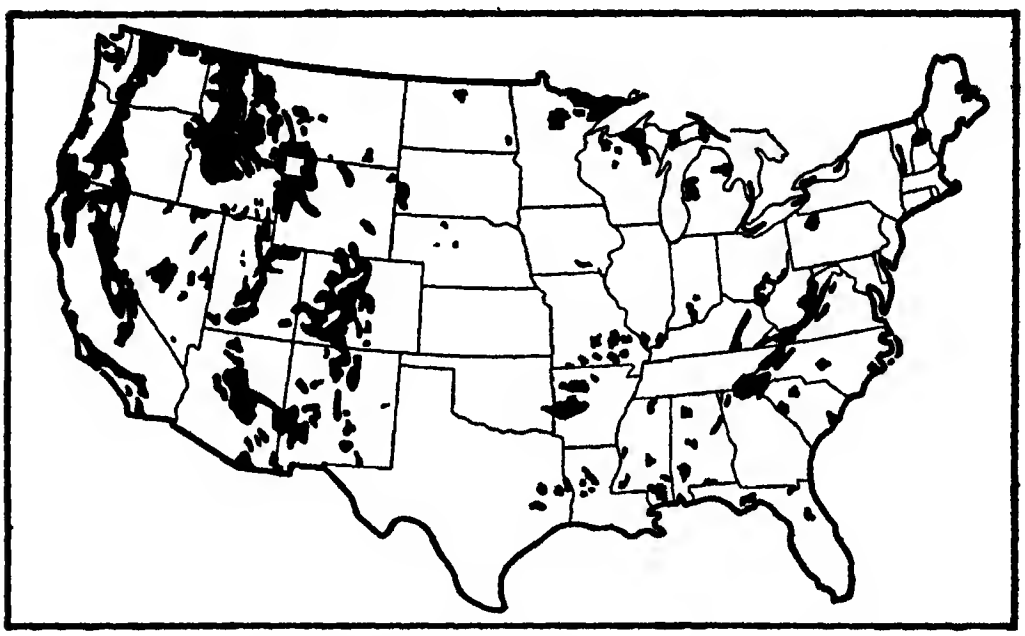

FIG. 2. National forest areas in the United States

and a variety of other things that must be durable out of doors. From this region we also get ponderosa pine (or western yellow pine, as it is called by many), the famous sugar pine, western white pine, hemlock, cedar, Sitka spruce, and the woods of a number of other conifers. There are not many broadleaf trees along the Pacific Coast, but we cut some alder, which grows to tree size there, besides some cottonwood, maple, birch, and a few other minor species.

In these vast dense forests, forest fires cause terrific damage. Smoke palls may drift over some of the western cities and hang for weeks during the hot dry spells of late summer. Where the

great fires start—set usually by careless campers or smokers—whole communities must get out to join the regular foresters in fighting them.

*Rocky Mountain Forests.* The forests of this region reach from Canada to Mexico. Near Canada they spread over mountain and valley alike, but they keep strictly to the high places in the southern Rockies, where moisture is scarce in the lowlands. The different species of trees arrange themselves in roughly parallel belts along the mountain slopes: for example, with spruces and firs in the top belt, pines lower down, and junipers and perhaps oaks at the bottom. If you ever take a trip up Pike's Peak, or, for that matter, up any western mountain, this zoning of forests will strike you at once. These belts tilt upwards on the southern end of the Rockies; that is, you must go higher there to find the same belt that is found lower down in the mountains in the North.

About 13 per cent of the total forest land of the United States, or some 63 million acres, is located in the Rockies. Like the forests to the west of it, the Rocky Mountain forest is dominantly a forest of conifers (Plate 55). The northern portion of it, in Idaho and Montana, resembles the Pacific forest, containing, as it does, an abundance of western white pine, cedar, and western hemlock. Generally speaking the forests of the Rockies have had rather tough going. They were burned by prospectors looking for outcroppings of gold, or silver, or copper; by the Spaniards who burned them to make way for sheep pasture, and by the tourists who followed in droves during the automobile era.

We get very little lumber from broadleaf trees in this region, but the conifer production is high. Douglas fir occurs here too, although it is smaller in the Rockies than on the coast. Ponderosa pine is of considerable importance also, as are Engelmann spruce, white fir, white pine, lodgepole pine, and larch.

*Northern Forests of the East.* First of all the land in this coun-

try to be logged, the northern forest now contains only very small areas of virgin timber. This forest is really only the southeastern end of a really gigantic coniferous belt that goes clear across the continent from Newfoundland to Alaska. In this country it covers the northern portions of the Lake States, most of New England, and sends an arm south along the main body of the Appalachian Mountains. In the southern end of it, as well as on the lower slopes of the northern Appalachians, it gets well mixed up with the central hardwood forest treated next. Even so, the total area of our northern forest is about 83 million acres.

It is in this region that the magnificent eastern white pine occurs in greatest abundance. This tree was at one time one of the most valuable timber trees in the world, and although it still ranks very high in the eastern forest, it has since dropped from its once-proud position. The best stands of it today are in Minnesota, Wisconsin, and Michigan. Other important conifers from this forest region are red and white spruce for paper pulp, balsam fir, red pine, eastern hemlock, jack pine, and white cedar.

Among the broadleaf trees of the northern forest are several kinds of birches, beech, sugar maple, basswoods, and red and scarlet oaks (Plate 1). Years ago the American chestnut formed more than half the stand in the Appalachians, but the chestnut blight has since reduced this splendid tree to a mere remnant (Plate 48). Beech and basswood we use extensively for boxes and crates, among other things, and sugar maple is highly valued for furniture making and interior finish, as well as for its production of maple syrup and sugar (Plate 52).

*Central Hardwoods Forest.* Covering an enormous area of the central eastern half of the United States, this great forest area contains the greatest number of species and the most broadleaf trees of any American forest. Most of the original forest of this region has long since been replaced by farmland, and the grandeur

and majesty of it are hard to realize today. The region includes over 132 million acres of land, and from it comes a substantial quantity of high-grade hardwood lumber, much of it cut in farm woodlands.

The species of trees in this region are mixed in bewildering variety, and not all of them are to be found throughout the area. Certain of the northern oaks are replaced by other species of oaks in the southern part of the region, and sugar maple, the formerly abundant chestnut, and shagbark hickory drop out as one goes south. At the same time, shortleaf pine, osage-orange, persimmon, and others increase in abundance in the southern areas. Over in Texas in the westernmost part of this forest region appear other species of oaks, and some junipers or cedars not found anywhere else.

On the whole, however, after many years of cutting, the grand forests of this region are nearing the end. Culled over repeatedly and heavily, the remaining stands are of pretty poor quality or hard to get at.

Our finest black walnut, aristocrat of the timber trees, is cut in this region for use in radio cabinets and fine furniture of many types. The ash lumber we use for all sorts of athletic and sporting goods, or axe, hammer, shovel, hoe, and other kinds of handles. A variety of oaks and tulip poplar come principally from this central forest, in addition to red cedar for pencils and cedar-chests, sycamore and elm for butcher's blocks, black locust for fence posts, cherry for cabinet-work, hickory, beech, maple, and a host of lesser species. White oak, so much used for 'hardwood' floors, occurs abundantly.

Southern Forest. In the region of the Deep South is found the most important remaining source of large timber in the eastern United States. The largest of all the forest regions, this area includes a little more than 149 million acres, the majority of them

in pine, but an important minority in wet-land hardwoods and cypress. The land is generally flat on the southern coastal plain, and logging operations there do not cost as much as in mountainous regions.

Of first importance are the southern pines, usually lumped together as 'yellow pine' by lumbermen. The four species that make up the bulk of the stands are shortleaf, loblolly, longleaf, and slash pines. The first one, shortleaf pine, has the shortest needles and is most abundant in the northern part of the region. The last one, slash or longleaf pine, has the longest needles and is dominant in the southernmost part. The others come in between. From these four pines we get enormous supplies of strong, stiff, tough wood of great value for heavy construction work—such as making wharves, bridges, ships, beams, joists, and the like. The bulk of the timber cut in the South comes from these four pines; and since the southern cut is about a third of the total for the United States, that puts the southern pines in a rather important position as far as lumber is concerned. But this is not all.

More than two-thirds of all the naval stores of the world are collected from the same four species of pine. The tar and pitch obtained from these trees used to be in demand mostly in connection with sailing vessels, hence the term 'naval stores.' Today the term refers to turpentine and rosin. The naval-stores industry, then, centers in southern Georgia and northern Florida, where you can see the characteristic cuttings on the pine trees in most of the pine forests (Plate 50). Eight to ten million gallons of turpentine and three hundred and fifty to four hundred and fifty million pounds of rosin come out of the South, either tapped from the trees or distilled from their wood.

In the lowlands and swamps of the southern forest region are also some very fine broadleaf trees. There is the red gum, or sweet gum, the wood of which we use so extensively for veneer. It is

stained to imitate mahogany or walnut, but it is a beautiful wood in its own right and takes a fine polish. Then there is the black gum or tupelo, much cut for making flooring, tobacco boxes, and many other wooden articles that need to be tough, light, and resistant to wear. A number of other hardwoods come from this section, including oak, southern cedar, magnolia, and many that come from the central hardwoods forest as well, such as ash, elm, hickory, beech, and sycamore.

All of our southern cypress comes from the southern low country. This great tree, closely related to the redwood of California, grows in the swamps along the rivers and coasts. It produces queer 'knees' that grow up from its roots and stick out of the water for all the world like a knee. So far, no scientist knows exactly what the knees are for. Cypress wood, like redwood, is extremely durable and is used wherever resistance to decay is important—as in shingles, water-tanks, and the like. The wood from trees near salt water is red to nearly black; inland the color is only slightly reddish to light cream.

*Tropical Forest.* On the very southernmost tips of Florida and Texas there are some 40,000 acres of forest over which botanists have argued for years. Sub-tropical says one school; tropical says the other. At any rate the two bits of forest are different from all the other types we have and approach the tropical very closely. We get no lumber or other wood products from them except in insignificant amounts.

These forests contain mangrove trees whose tangled, arching roots carry the trees above the salt water in which they grow. Wild mahogany occurs there in minor amounts, and there are royal palms in the Florida portion (Plate 54). The rest of the trees are perhaps no more than names to most people. There are bloodlies, gumbolimbos, Jamaica dogwood, wild tamarind, wild fig,

pigeon plum, poisonwood, inkwood, and others that are suspected of having sprung from seeds washed ashore or brought from the tropics by birds.

## Good and Bad Forestry

The easiest and most obvious way to harvest a forest is to cut it down and haul it away. This is an admirably direct way to go about it, and it certainly produces immediate results. This particular method was widely used in the heyday of lumbering during the last century, and it is still used to a very considerable extent in the West.

After the lumber is hauled away to the sawmill, there is left on the land a mass of trimmings and slashings that eventually dry out and very commonly catch fire. The fire is equally direct and immediate in its results, and when it finally goes out or is put out, the land is left pretty bare. The first time it rains, the water begins to wash soil away, because the fire burned the leaf litter and mold that used to absorb and hold the rain. Quite a little soil may wash away before blackberries and various kinds of weeds form a protective cover that will prevent soil erosion, at least in part. Since the trees were all cut down, there are no seeds to start a new forest, and, of course, the fire killed most of those hidden in the litter on the old forest floor. It may be many years before a few tree seeds drift in. In the meantime the soil has been heated by the fire, then partially washed away, then baked in the hot sun of summertime. Trees cannot get started as easily in this soil as they could in the original soil of the forest.

By this time it may occur to you, as it did to earlier forest landowners, that if you want any more trees to cut, there is not much left to do except plant them (Plate 50). You realize, of course, that it takes trees many years to get big enough to be worth cutting, and in the interim there will be taxes to pay. Counting the

cost of planting new trees, plus the taxes for several decades, it may look as though the best thing to do is to dispose of the land. Farmers may not want it; after all, the soil is no longer rich and fertile and the blackberry thickets and tangles of shrubs grown up since the fire will have to be cleared. Perhaps you had better let it go for the taxes and let the Government take it over.

Well, the Government gets it. The logged and burned-over land is worth no more because it is Government land. But the Government has to do something with it; the public does not approve of letting public lands lie idle and worthless. So, government experts survey the land, examine its soil, determine what use can be made of it, and perhaps decide on using it for forest production. From the tree nurseries maintained by the Government are sent young trees to be planted on the old burn. All the costs are met by the Government, that is, by you and all the rest of the people who pay the taxes and elect public officers.

You may recall that a substantial part of our 495 million acres of commercial forest land is in a condition that approaches the situation just described. The Government owns some, but most of it belongs to companies or individuals who must make the best of what they have.

But there is another way of harvesting a forest. Instead of cutting all the trees at once, you cut only those that are ripe for cutting. In a few years, more trees will be ready to cut, and in the meantime young trees are coming up to replace those taken out. By managing carefully, a constant and continuous supply of timber can be harvested from the piece of forest, because the forest will continue to renew itself. There is no erosion to worry about because a good forest cover prevents soil from washing away in any but the most minute quantities. There is no cost to the Government. This method, generally known as selective cutting, takes

more skill than the direct method of clear cutting, but its benefits are obvious.

If you were to discuss forestry with an expert forester, he could tell you of many refinements in the methods of practicing the art. He might indicate the necessity for protecting forests from fire; and describe fire-lanes, fire-fighting methods, precautions to take, and so on (Plate 51). He would probably tell you that pasturing livestock in farm woodlands is poor business both because there is not much food for grazing animals in a woods, and because livestock usually eat the young trees that would otherwise have grown up to renew the forest. The forester would, if pressed, tell you about thinning operations designed to permit only the best and strongest trees to grow, and of salvage operations aimed at cutting out trees that are diseased or too old, or not very good for timber anyway.

As the forester talked, you would come to realize that while good forestry is based on common sense, it has made use of methods developed from scientific study and long experience. And you would probably form a picture in your mind of a well-managed forest of healthy, vigorous trees of different ages and sizes, containing a good undergrowth with plenty of young trees coming, well protected from fire and livestock, free of diseased or crooked trees, and a long-continuing source of pride and profits to its owner.

## What We Get from Forests

The first product one thinks of as coming from forests is lumber, and there is no question but that this is the primary product of many forests. But there are a great many other values, some of which may be much more important than wood, at least in certain localities. Forests that protect the watershed supplying water to a great city, for example, are far more valuable living and growing than they would be if cut for lumber. Then too, not all for-

ests produce timber of high quality, hence it often happens that such forests are better used for other purposes, such as recreation or for wildlife. Nevertheless we usually produce 40 billion board feet of lumber each year in this country. (A board foot is a piece of wood an inch thick, a foot long and a foot wide, or the equivalent.) We send about 8 per cent out of the country, use 32 per cent for construction work, 33 per cent for planing-mill products such as doors and floors, and the rest for boxes, furniture, railroad cars, wagons, and hundreds of other miscellaneous articles made out of wood.

Every year we cut and make up about 900 million fence posts to use for fencing land. To carry telephone, telegraph, and electric wires, we use about 3 million poles, and many millions more for piles in harbors, wharves, and bridges. The ties on railroad beds are made of wood treated with preservatives, and we use many millions of these each year. Mine timbers, for propping up mine tunnels, are used in enormous quantity wherever there are mining operations requiring them. And for fuel we burn perhaps 80 million cords of wood in a year's time.

From the more beautiful woods we make veneers by cutting them in thin slices to be glued on cheaper wood. Cheap woods can themselves be sliced thin, then the sheets glued together with the grain of successive layers running in opposite directions, to make plywood. This kind of 'made' wood is very strong and does not warp or crack as easily as natural wood. Besides this, we use an enormous amount of wood to make barrels, shingles, excelsior, and matches.

For paper-making, some 10 million cords of wood are required each year. It takes about 80 acres of spruce forest to put out one Sunday edition of a New York newspaper. Spread that figure to include all the newspapers, books, wrapping paper, and similar

products that we use, and you will have a rough idea of how fast paper-making can eat up forests.

Next, we distill a great deal of wood to get a number of chemical products, such as charcoal, acetate of lime, wood tar, wood gas, and even turpentine, rosin, and oils. The many uses for charcoal are fairly well known. Acetate of lime goes to make acetic acid (the acid that makes vinegar sour), used for making paints, textiles, and leather goods, or acetone, which goes into chloroform and explosives. The tars and oils go into the manufacture of creosotes and stains.

Turpentine can be obtained, as we noted earlier, either from distilling wood or by tapping trees. You can see turpentine work in many parts of the South where the bark of pine trees is cut to permit the pitch to run out (Plate 50). The pitch yields rosin and turpentine. From other kinds of trees we collect balsam and spruce gum. In order to tan leather, we extract tannin from the barks of oak or hemlock, or from the leaves of sumacs. And from some forest species we get dyes.

We are careful now to see that the headwaters of streams in country that was originally forested have a good forest cover left on them. Such protection forests insure against floods, and assure clean, well-regulated supplies of water. In many of our forests recreational use is of the greatest importance, and in these we build roads and trails, and set up overnight cabins for the use of those who hike or ride or canoe. Some forests are best adapted to the production of wildlife, and are so used, but all forests, if they are wisely treated, can be productive of wildlife even though their primary use is for something else. Grazing is permitted in certain kinds of more open forests, and as long as it is carefully and properly controlled, the grazing can be kept in harmony with other uses.

It is possible to go on listing dozens of other ways we use for-

ests. Maple sugar and syrup come from them, so do certain drugs, such as cascara. Enormous crops of pecans are harvested from wild pecan trees in the southern forests, and other nuts like hickories, black walnuts, and pinyon pine nuts are gathered in large quantities where they are available. From forests come plums, blueberries, and many other kinds of wild fruits. We get our Christmas trees principally from forests, and our Christmas greens like holly, ferns, mosses, and mistletoe as well.

In the aggregate American forests are worth an enormous sum. Fuel, rough timber, lumber, naval stores, paper pulp, drugs, dyes, fruits, nuts, Christmas decorations, and other forest products run into the billions. Watershed, recreational, and wildlife values, although less easily measured, certainly add many billions more. And for generations, America can continue to profit by these values and products, just so long as the forests are properly and wisely managed.

## XIV

# LAND FOR WILDLIFE AND RECREATION

Not so very long ago it would have been pretty hard to find any American land actually set aside for wildlife. The fact is that except for an occasional game preserve or shooting ground, which any prudent wild creature would do well to avoid, wildlife land had rather generally disappeared by 1900. Actually, nearly all the land in America might originally have been classed as wildlife land; certainly wild animals enjoyed the use of it without interference except by a sparse population of Indians. But by the time America was well settled, and laid out in farms and cities and cattle ranges and timber preserves, any land left for wildlife was largely an accident: that is, nobody needed it for anything else.

America has gone through a number of phases in so far as wildlife is concerned. To start with, the original, amazing numbers of wild animals led early settlers to believe that there need be no fear about killing too many. To destroy all the wild pigeons that flew overhead in flocks estimated to contain millions of birds seemed altogether impossible—yet we succeeded in doing just that. The little green parrakeets of the eastern and central portions of the country were present in myriads—but we wiped them out also. It was beyond all reason to suggest that the millions upon millions of great shaggy buffaloes could ever be cut to thousands—but we did better than that. We cut the great herd in two by building a railroad across the Plains in 1867, then set to work on the divided forces, until by 1895 we had exterminated all the wild buffalo.

In a Brookings Institution report, Jenks Cameron expresses the early attitude rather well (p. 4):

It was inevitable [he says] that his environment should have bred in the early American settler a fixed idea and a trait. The fixed idea was a conviction that any such thing as the extermination of game was impossible. The trait was a prodigal disregard for not merely game but wild life of all sorts, comparable to the solicitude which the boy with a stick in his hands feels for the weeds by the wayside. And both the trait and the idea were transmitted to the early settler's children and to his children's children. And along with them were transmitted the fierce conviction that the free-born American had the right to bear arms, and to 'gun' pretty much where, when, and how he pleased.

The second phase in our wildlife history came about as game began to get scarce. A great number of laws were passed, not to protect game, because nobody worried about game being exterminated, but to assure a sufficient supply so that the ordinary citizen could get a little wild meat whenever he wanted it. The men who were killing game as a business were making it difficult for the ordinary person to hunt with any degree of success in the nearest woods; hence the laws tried to stop the commercial hunting.

The third phase began about 1850, when America began to get uneasy, then downright worried, over the possibility that some kinds of game might actually be wiped out altogether. Things got worse. One species after another began to dwindle alarmingly in numbers. Commercial killing for hides, meat, or plumes went on briskly; so did large-scale gathering and sale of wild birds' eggs. Eventually the growing fear that America was in a fair way to lose some of its valued animals resulted in a new idea—the setting aside of refuges for wildlife of various kinds to prevent their final, total destruction.

By the turn of the century a considerable battle was in full

swing. A number of societies and public-spirited citizens were attempting to get something done; opposing them were business interests that were making money out of the commercial sale of plumes for miladies' hats. Finally in 1903 the first national bird refuge was set up by Theodore Roosevelt to protect a colony of brown pelicans off the Florida coast. This was a grudgingly slow start. Pelican Island was only five acres in extent and although there was a warden to police the refuge, most of his salary was paid, not by the Federal Government, but by the American Ornithologists' Union, a society of scientists and students of birds. As time went on, however, the Federal Government set up more refuges, finally taking over full control—warden, salary, and all.

Pelican Island may have been only a five-acre beginning, but it was one visible expression of an idea that has expanded enormously during the past 40 years. The idea is best expressed in the one word: conservation—meaning wise use—a word that is now a very familiar one. The wise use of forests, of soil, of coal, oil, wildlife, and other natural resources is an obvious necessity now, but the conservation movement had a long, uphill pull when it was trying to get under way.

One by one, new refuges were added to the list headed by Pelican Island. In Sequoia National Park was set up the first of a series of areas designed to provide protection for big game. The Sequoia area was created in order to care for a small band of dwarf elk presented to the Federal Government by two conservation-minded ranchmen, Miller and Lux, of California. In 1908 Klamath Lake, Oregon, was established as the first refuge for waterfowl, and within 10 days Malheur Lake in the same State followed. These areas and many more like them were set up not as parks, or forests, but for no other purpose than to provide sanctuary for wildlife. In this respect they were different from, say, the first National Park,

which, although it gave complete protection to the wildlife within its borders, was not created with that purpose alone in mind.

By this time all the land used for wildlife refuges amounts to a great many million acres. Exactly how many cannot be determined until someone studies the problem, since there is considerable duplication and confusion in the figures now to be had. The States report almost 50 million acres of refuges, some of which are no more than hunting preserves, and some of which are maintained co-operatively with Federal agencies. The Federal agencies report their refuges and include all they have anything to do with. Thus the Forest Service reports 18 million acres of State refuges within National Forests, and some 6 million acres of Federal refuges. The Fish and Wildlife Service reports about 9½ million acres of refuges, but some of these are also reported by the Grazing Service, the Reclamation Service, and certain States. The National Park Service reports 17 million acres in parks and monuments on which wildlife is protected. Altogether we may assume that perhaps 90 million acres are used for wildlife in national or State refuges of one kind or another.

There is no way you can detect land devoted to wildlife refuges except by the printed signs that declare the area to be such. The way of life of a duck requires land of one sort, usually a swamp or marsh or lake. A mountain goat requires a mountain, as it were; an antelope ordinarily needs grassland, and a black bear lives in the forest. Thus, as might be expected, wildlife land can be grassland, forest, or desert; level, hilly, or mountainous, depending on the kind of wildlife to be benefited. There are the rocky islands, like Pelican Island, that lie off our coasts and serve to protect colonies of such birds as terns, cormorants, gulls, herons, and egrets, as well as pelicans, murres, puffins, and auklets (Plate 53). There are the big game refuges that harbor buffalo, elk, deer, antelope, mountain sheep and goats, peccaries (the American wild pig),

PLATE 55. Scene in Glacier National Park (Kintla Peak and Lake). Finest of recreation land, areas like these are preserved for the use of all the people.

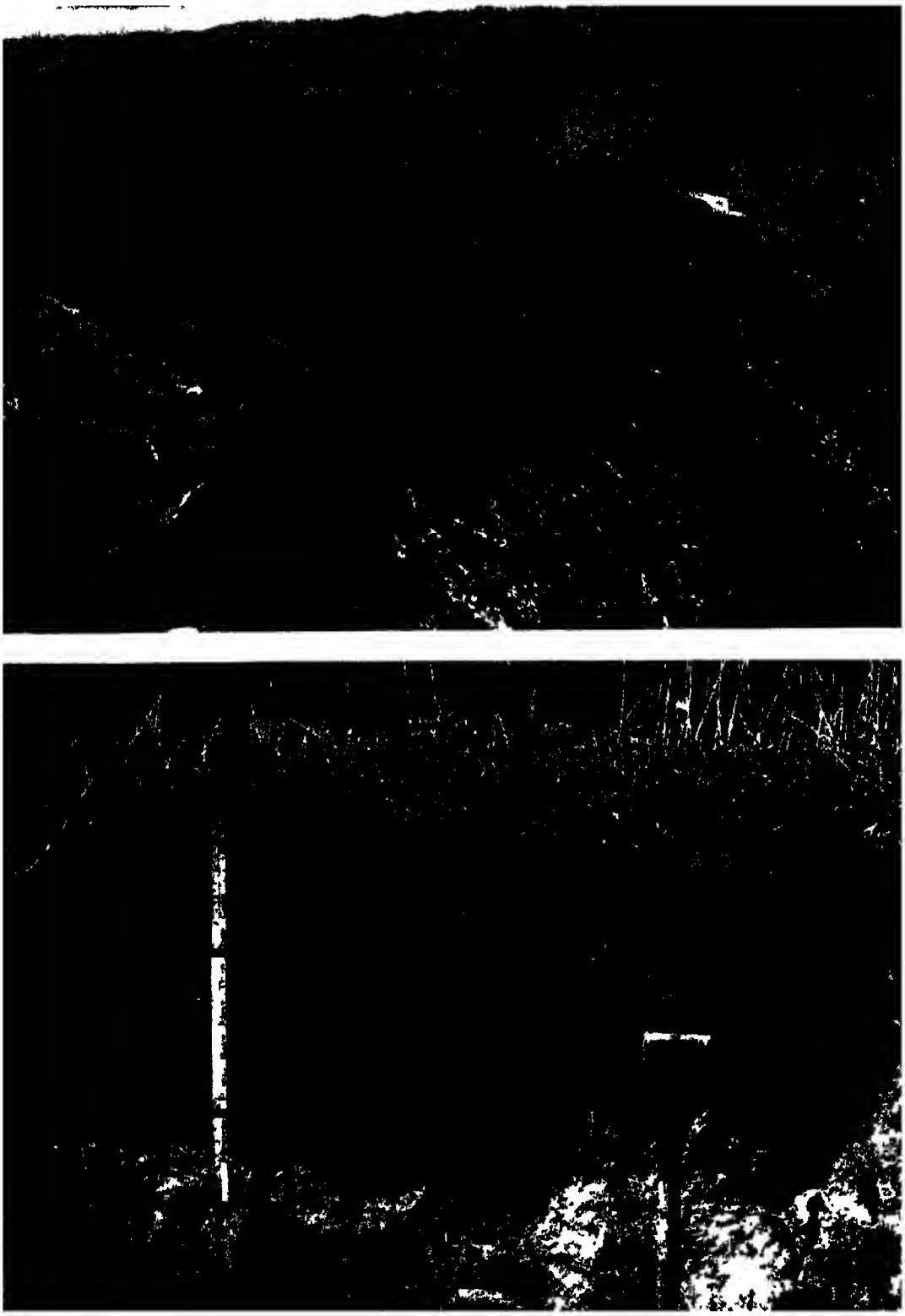

PLATE 56 Grand Canyon of the Colorado River in Arizona. Now a National Park, this area is an outstanding example of geological erosion.

BOTTOM. Perhaps the most important of all American resources—topsoil. This particular layer is 2 feet thick but not all topsoil is as thick or as dark in color.

grizzly bears, black bears, and others (Plates 2 and 53). Then there are the refuges for waterfowl—ducks, geese, swans, cranes, spoonbills, and the like—principally associated with lakes, marshes, swamps, rivers, or coastal bays and inlets (Plate 52). Besides these, areas have been set up for sage grouse, prairie chickens, and other upland game birds, as well as beaver, muskrat, and other fur-bearing animals.

### Agricultural Wildlife Land

So far, we have been discussing land used for wildlife as though all of it were public land, but there is a substantial area of wildlife land on private farmland. The total has been estimated at about 33 million acres. There is no way of discovering how much of this area actually provides sanctuary for wild creatures, because while some farmers will not permit any hunting on their lands, most will and do.

The 33 million acres include land within farms that is clearly unfit for production of cultivated crops, hay, pasture, or trees. It consists of thousands of small areas scattered through better classes of land—which is a fortunate situation since the bits of wildlife land harbor enormous numbers of insect- and rodent-destroying birds and mammals useful to agriculture.

Again, as with public wildlife land, you would have difficulty identifying agricultural wildlife land. Some of this land has been so gutted by erosion that it is worthless for anything else. Narrow strips of it are to be found along streams, drainage ditches, and irrigation ditches where use of the soil for ordinary crops is out of the question. Marshes that cannot be used for farming, because drainage is uneconomical, and the thousands of farm ponds are part of this wildlife land. So too are the many infertile and unproductive spots of land interspersed with good land, and that are

not worth cultivating and planting because they will not produce a crop (Plates 54 and 64).

By no means all the 33 million acres is now treated properly. Land users still plow too close to streams, cutting off the shrubby cover that keeps the streams from cutting into their banks. Farmers still waste labor and seed and fertilizer on infertile areas when they should be devoting their efforts to more productive land. But as the wildlife lands of agriculture are recognized for what they are, and vegetation is permitted to cover them—or is purposely planted on them—then wildlife of many kinds will find better places to live on the 85 per cent of American land that is used for the production of crops.

## Land in Parks

Back in the year 1870, nine civilians, six soldiers, two packers, and two cooks set out to explore the Yellowstone country in northwestern Wyoming. There had been some decidedly tall tales coming out of that region. One of Lewis and Clark's men by the name of Colter had been there in 1807—probably the first white man ever to put foot in the Yellowstone area—but his remarkable stories were altogether too fanciful for anyone to take seriously. But the rumors kept coming. Up in the region people had taken to calling 'Colter's Hell' there seemed to be some exceedingly strange things going on. Our party of 19, officially known as the Washburn-Doane-Langford expedition, set out to get the story straight. The party went by pack train, equipped with the military escort to help fight off any unfriendly Indians.

The marvels that expedition found are now well known. Geysers of steaming water, craters filled with boiling mud of many colors, boiling springs, great canyons, a myriad of exquisite lakes, and mountain scenery of a grandeur and beauty beyond description—all these the party came upon, one after the other. The men had

been skeptical, but 'never was a party more completely surprised and captivated with the wonders of nature.' What they saw seemed almost beyond belief.

Lounging around their campfire one evening, talking of the wonders they had seen, the men fell to discussing what might eventually happen to this remarkable area. Obviously it would be profitable indeed to take up land surrounding the best of the natural phenomena, and to charge admission of the tourists that would one day certainly arrive in hordes. But no, said one Cornelius Hedges, no portion of the region should be permitted to get into the hands of private owners. Rather, he believed, 'The whole of it ought to be set aside as a great National Park.' Remember that such an idea was altogether new, and chalk it up to the everlasting credit of the men that Hedges's suggestion was received with enthusiasm. Together they would strive to make it come true, and each would do all he could to bring about the creation of the first National Park. And so, as it happens, they did, collectively and individually, do everything possible to preserve the marvelous region.

Two long years of work, and then on the first of March in 1872 President Grant affixed his signature to an act of Congress which declared the Yellowstone area to be 'reserved and withdrawn from settlement, occupancy or sale under the laws of the United States, and dedicated and set apart as a public park or pleasuring ground for the benefit and enjoyment of the people.' The act provided as well for the 'preservation, from injury or spoliation, of all timber, mineral deposits, natural curiosities or wonders, within the park, and their retention in their natural condition.' Visitors were to be accommodated, places set aside for buildings, roads and bridle paths built, and fish and game protected from 'wanton destruction.'

Thus was created the first national park in the United States, and for that matter, in the whole world.

Over 21 million acres are now included within the National Park system (including Alaskan areas). 'Every acre is to be forever preserved in its natural state for the benefit of this and future generations,' wrote former Director Albright of the Park Service. 'There is no commercial exploitation, no cutting of timber, no development of power, no mining except in one or two special cases, no hunting of wildlife, and no grazing except in a few special cases.' Roads and trails there are, within limits, but enormous areas within this parkland are to remain free of any development whatever. In these wilderness areas are preserved America as it was before we came. Here, as one man has described it, is a National Museum of Original America.

'Surely our people do not understand even yet the rich heritage that is theirs,' wrote Theodore Roosevelt. 'There can be nothing in the world more beautiful than the Yosemite, the groves of giant sequoias and redwoods, the canyon of the Colorado, the three Tetons; and our people should see to it that they are preserved for their children and their children's children forever, with their majestic beauty all unmarred . . .'

The magnificent array of parks we now have deserves really extended treatment for each one, and that has been done beautifully by Harlean James in *The Romance of the National Parks*, published in 1939 and illustrated profusely with excellent photographs. Here we can do little more than consider the kinds of lands that have been set aside.

Yellowstone we have already spoken of as especially interesting because of the volcanic activity that goes on within its borders. There are more geysers in it than there are in all the rest of the world. There are other outstanding examples of vulcanism. The only recently active volcano in the United States is Mount Lassen

in California; it was set aside in 1916. Crater Lake, Oregon, is a vividly blue lake in the crater of an extinct volcano. The lava cliffs surrounding it tower 500 to 2,000 feet above the surface of the lake.

Then there are the western mountain parks both along the Pacific Coast and the Rocky Mountains. There is Glacier National Park at the top of the Rockies containing some of the finest mountain scenery in the country (Plate 55). Near Yellowstone, there are the Grand Tetons, which this author considers the very finest of all the mountains in the United States. Yellowstone itself contains mountain scenery of tremendous grandeur. South of these parks in Colorado is Rocky Mountain National Park, containing more than a quarter of a million acres of tumbled mountains with 65 peaks higher than 10,000 feet.

In the Cascade-Sierra mountains along the West Coast is Mt. Rainier National Park with its great single peak, companion ranges of jagged peaks, and the greatest glacier system in size and beauty of any we have in this country. West of Rainier are the Olympics, highest mountains of the western Coast Range, and notable for their magnificent forests and the rare Roosevelt elk. In California is Yosemite, a great valley of granite, with waterfalls of immense height, and incomparable forests (Frontispiece). South of it is Sequoia, containing the famous California big trees or sequoias, largest trees on earth. Adjacent to it is King's Canyon, a superb wilderness area dominated by the highest peaks of the Sierra Nevadas and the enormous canyon of the King's River.

One of the outstanding examples of geological erosion is the Grand Canyon of the Colorado River in northwestern Arizona (Plate 56). The great chasm, although not the deepest in the United States, is a mile in depth. North of it in southern Utah are Bryce Canyon, filled with fantastic pinnacles of highly colored material, and Zion, with its remarkably carved sandstone cliffs bordering a deep valley. To the west of these in southern Colorado is

Mesa Verde, which contains steep canyon cliffs eroded in the mesa and the best preserved cliff dwellings known in America.

We have fewer National Parks in the East, but what we have are outstanding. There is Acadia National Park in Maine, with its superb coastal scenery. The outstanding scenic sections of the Blue Ridge Mountains of Virginia are included within Shenandoah National Park. South of it, at the lower end of the Appalachians in North Carolina and Tennessee, are the Great Smoky Mountains, with nearly half a million acres of the finest original forests of the East and the highest mountains east of the Mississippi. In Michigan there is Isle Royale, a wilderness island with one of the largest single moose herds in America. In Florida is the Everglades section, about to become a park, and containing a magnificent tropical jungle with all its birds and other wildlife (Plate 54). West of it, in Texas, is the Big Bend area of the Rio Grande, with its spectacular desert and mountain scenery plus its strange plant and animal life.

Some parks are underground. Such are Mammoth Cave in Kentucky, Wind Cave in South Dakota, and Carlsbad Caverns in southwestern New Mexico. In parks like these are to be found labyrinthine passages filled with stalactite and stalagmite structures of amazing variety.

Besides the National Parks, there are the National Monuments, distinguished as areas set aside to preserve 'historic landmarks, historic or prehistoric structures, and other objects of historic or scientific interest.' There has been some confusion about this. Grand Canyon was once a monument; now it is a park. Death Valley, unique desert area in California, is a monument at the present writing; so are the Craters of the Moon in Idaho, and the Sahuaro and Organ Pipe cactus areas in Arizona. A 'monument' merely preserves, while a park preserves and develops for the more

complete and perfect enjoyment of the people. Monuments are often classed as Park 'raw material.'

At any rate our 'National Gallery of Scenic Masterpieces,' as Robert Sterling Yard called our parks, is a collection of which Americans may well be proud. It is a system of which Americans must ever be jealous, lest the masterpieces it contains be marred by those who are ever ready to exploit them for private use. There are still certain people who would dam rivers, cut timber, graze livestock, or open mining operations within the boundaries of the lands that have been set aside for the enjoyment of *all* the people.

## XV

# EROSION

THE soil that makes land productive is not very thick. Over the United States as a whole its average depth is between 7 and 8 inches. It can be washed or blown away in a remarkably short time, and after it is gone, it cannot be replaced for a very long time. Nobody knows how long it takes for natural processes to build an inch of good soil, but some scientists have estimated that it requires between three and ten centuries. For 8 inches this means between 2,400 and 8,000 years.

It may never have occurred to you that the uppermost layer of soil—topsoil—is of very great importance. After all, there seems to be plenty of it, and it looks to be many feet thick. But the deeper you dig, the poorer soil gets. It is only in the thin layer on top that plants get most of their food. In turn, animals feed on the plants and mankind depends on plants and animals for food. Where topsoil is rich and fertile, we can grow a great deal of food. Where it is poor, not much can be produced. That is why topsoil is one of the most valuable resources we have (Plate 56).

People in colonial days did not feel that topsoil was particularly valuable. In those days if you wore out a farm, you could always get another one. You went west, and west again, and you could get a new piece of land with virgin soil because there was always more land. But now there is no more. All the land suitable for farming is taken up; every foot of it belongs already to someone else. If you wear out a farm, you must either buy another one or go without. And if you wear out a farm as most people do, you will not be

able to afford a new one because your money will be gone also.

These statements may sound ridiculously simple, especially to people who read books. But to many millions of people who have learned these truths by bitter experience, they are not ridiculous. When productive topsoil is washed or blown off fields, crops no longer pay, and those who live on the land go into debt. Eventually they must leave behind them a ruined piece of land, worthless to those who come after.

Fifty million acres of American cropland are now ruined for farming. This is as big an area as the whole of New England plus Maryland and New Jersey. But there is more than this. Another 150 million acres of arable land has been so gutted by erosion that farming on it is bumping and grinding to a stop. On the rest of our farm land—880 million acres more—erosion in greater or lesser degree is apparent nearly everywhere.

## What Erosion Is

Many years ago the only people who talked much about erosion were geologists—the scientists who study the natural processes that shape the earth. They were interested in the gradual wearing away of mountains, in the way glaciers and streams cut valleys, in the manner in which plateaus and mesas were formed. These scientists knew that normal, natural erosion was a slow process, so slow that thousands of years might pass before a noticeable impression would be made on the surface of the land. This is still true. Only by the most precise and careful measurements and long-continued study can we determine changes taking place under the slow workings of geologic erosion (Plate 56).

But there is another kind of erosion called accelerated or man-made erosion. This is usually the kind people are talking about these days. It is terribly rapid. It has resulted in frightful destruc-

tion of land, good land the world cannot afford to lose. And, it can be stopped.

Man-made erosion is a rather simple matter. When rain falls on bare soil, it washes away the uppermost particles and runs off as muddy water. When water is muddy, it is carrying soil. The faster it runs, the more soil it can carry (Plate 57). When it slows down, it begins to drop soil; and when it stops running altogether, eventually nearly all the mud settles out and the water becomes clear again.

This simple process, operating on a big scale, becomes spectacular and terrible. On great fields without any kind of protecting cover, soil may literally be carried off in sheets. Wherever there is a small channel leading downhill, the muddy water runs faster and carries more soil, digging into the earth to create a gash. The gashes are small at first, perhaps no larger than little rills (Plate 57), but as the water cuts away soil, the rills enlarge and eventually they become gullies (Plate 58). Some gullies have become enormous canyons extending across whole counties and involving tens of thousands of acres (Plate 59).

Gullies are the symptoms of erosion most easily observed. Almost anywhere in the United States you can see all you want in an afternoon's ride through the countryside. The gigantic canyons, luckily, cannot be seen everywhere, but it is not difficult in rolling or hilly country to find gullies 3 to 10 feet deep. In parts of the country where soils are easily eroded, you may find gullies that have eaten their way across fields right up to the road. Sometimes they take the road out.

Sheet erosion is more difficult to see than gully erosion. The process of removing thin sheets of soil from fields is insidious. The results can sometimes be detected by noticing light-colored patches in fields of dark-colored soils, especially on the tops of little hummocks or hills (Plate 10). Sometimes, immediately after

a rain, fields can be seen with thousands of tiny rills running downhill (Plates 57 and 58). Or, if the road you are on happens to be lower than the adjacent fields, you may notice deposits of mud lying across the pavement. The mud usually has been washed off the fields above, and is an indication that sheet erosion has been going on during the last rain.

Usually farmers plow the fields again and the rills disappear. The fields look to be in good shape; but they have lost another fraction of an inch of soil. Year by year more fractions wash away. Pretty soon the topsoil gets so thin that crops will not grow as well as they formerly did. The land is wearing out. Anyone who will take the trouble to dig a little hole and measure the depth of the topsoil can discover how much of it has washed away. A hole dug in a near-by piece of soil that has not been farmed—a railroad right-of-way, a cemetery, an undisturbed woodland—will display a depth of soil like that originally present in the field. Even farmers who have worked a field for many years are often surprised on seeing the results of such a simple test.

Besides erosion by water, there is another kind all too familiar to people in the Great Plains. This is wind erosion. The process is much the same as with water, except that the particles of soil are carried off by the wind. A little wind carries a little dust. The faster it blows the more soil it carries (Plate 60). When the wind dies down, the dust settles out of the air. As with water erosion, the topmost soil—always the best soil—is taken off first. When the wind is strong and dry, and large areas of soil are exposed, enormous dust clouds may blow up and darken the sky. The dust is part of the thin productive layer of topsoil.

The dust storms may get very large. There are examples, and recent ones, of clouds of dust traveling as much as 1,500 miles. Topsoil dust from the Great Plains has darkened the skies over New York and Washington for several hours at a time. Airplanes

have had to climb to 15,000 feet to find clear air. The dust came from farms, from land where crops are grown that we must have to live.

## Some Results of Erosion

As man-made erosion progresses, farming becomes more and more difficult. Where gullies get a good start, farm machinery has to be taken around. Fields become cut into small pieces of land, and equipment has to be hauled from one place to another, because when gullies get to fair size, you cannot cross them with plows. As the gullies finger out, eventually they may—and do—undercut barns, houses and highways.

In the meantime, as the layer of topsoil gets thinner and thinner, crops do not yield as great a harvest as they did in the beginning. It still costs as much as ever to plant, and plow, and fertilize crops, but the returns are not as great. The margin of profit grows smaller. Farmers have to borrow money to make ends meet. When the time comes that the land will not produce enough to pay for the seed and fertilizer and labor to cultivate it; when the margin of profit has disappeared, in other words, then the user of the land goes bankrupt (Plate 59).

Notice too, that as the topsoil gets thinner, plants do not get as much plant food as they do on good soil. Plants grown on poor soil are lacking in certain minerals or other chemical elements. Hay may seem to be hay, but hay grown on poor, worn land and fed to cattle lacks necessary nutrient materials to be found in good hay. Cattle apparently getting enough to eat actually may starve as far as certain minerals are concerned. The food we ourselves eat may look the same, whether it comes from poor land or rich land, but it is entirely possible for various mineral deficiencies to upset our diets no matter whether our appetites seem satisfied or not. Complex and unstudied as this field of nutrition has been, there are ominous warnings of danger ahead.

Besides such effects of erosion as those in the crop fields, there are others no less far-reaching. From dust storms come many unexpected results. People breathing dust get 'dust pneumonia.' Everyone has more work to do as grit and sand covers homes and offices with dust. Machinery wears out sooner, motorists have trouble driving safely, and where the dust piles up, forming dunes, good land may be entirely buried (Plate 61).

The muddy water that washes off crop fields has to go somewhere. If it flows out onto good fields below, level fields where the water runs more slowly, it drops soil, eventually covering the topsoil of the lowland with poorer and poorer soil from the hills. Or, as the muddy water gets into streams it may drop its load of soil in the slower-flowing stretches, building great banks and beds of silt. As the load of silt continues to be deposited, the streams begin to change their courses, cutting into useful land as they do so.

As the streams grow into rivers, the load of silt they carry begins to do all kinds of damage. Fish cannot live in silt-bearing water. Reservoirs choke up with mud, and great engineering projects are rendered short-lived and useless long before they should be. Because more water runs off poor soil than off rich fertile soil, as erosion progresses more water runs from the fields. With stream and river channels clogged with beds of silt, and with more water than ever flowing to the sea, widespread floods begin to take place downstream. River channels fill, the levees must be built higher and higher, and a break-through means disaster for the inhabitants of large areas.

The vicious piling up of evil on evil is staggering to contemplate. The reader will have recognized the many effects of erosion discussed above. These things are happening. We have millions of acres of worn-out land that was once fertile and useful. We have food of poorer quality, fewer fish in our streams. Our floods have

been getting increasingly severe for the past 40 years. Like a snowball, erosion and its ills increase as the whole wasteful process gathers speed.

## The Geography of Erosion

Erosion, with all its associated evils, is not a local, sporadic process limited to this or that section. Nor is it limited to plowed land, although we have been talking about it as though it were. It is taking place on land wherever the land is being misused, and this, until ten years ago, included just about all the land we use for agriculture, including grazing. And, as you may remember from the second chapter, 85 per cent of the United States is used for this purpose.

Other things being equal, two things affect the speed and severity of erosion. One is the kind of soil, the other is how steep the land is. Some soils wash easily, seeming almost to dissolve in water like sugar. Other soils wash much more slowly. But all of them erode faster the steeper they are. A really steep hillside erodes faster than a nearly level piece of land, provided the soils are the same. These things being true, we might expect to find the worst erosion in hilly country, where the soils wash easily. And so we do.

Along the foothills of the Appalachian Mountains erosion has taken a terrific toll. Some 20 per cent of this foothill section—the Piedmont of the Southeast—has already been abandoned principally because of erosion. Enormous gullies, 100 feet deep or more, can be seen in this section that are rare in other places.

In the Pacific Northwest, where agriculture is not much more than 60 years old, erosion has been at work long enough so that land is already being abandoned. Extensive areas in the great Palouse wheat region have already eroded so much that rocky outcrops are now showing through the clothing of soil, fast wearing thin.

In the Corn Belt, where a lion's share of the nation's food is

produced, large areas—measured in millions of acres—are eroding seriously. Even in this relatively level country, several million acres are worn to the point where three-fourths or more of the topsoil is already gone. In spite of the magnificent advances in crop management and despite the remarkable development, by plant breeders, of hybrid corn and more productive crops of other types, the land has deteriorated so rapidly that yields in some localities are little better than they used to be.

On the great area of western range, too many cattle and too many sheep have eaten the grass away too fast to keep a decent cover on the soil. Wind erosion, gully erosion, and sheet erosion have taken and are taking topsoil from a land where the topsoil was extremely thin to start with. Probably 10 per cent is in good condition. The rest is overgrazed and eroding in greater or lesser degree.

So it goes the country over.

## The Primary Cause

When scientists came to study man-made erosion, they discovered a great many things about it, but there was one simple fact that stood out above all others:

*If soil had a cover on it, wind or water could not carry it away.*

Remove the cover and erosion could really operate. Put it back, and erosion would slow down or stop. The better the cover, the less erosion (Plate 57).

We noticed in the beginning chapter that the land surface of the United States generally had a very excellent cover on it when the earliest settlers arrived. The cover was composed of vegetation that had been present for untold ages. The vegetation was luxuriant forest or a heavy sod of grass, depending on where land was located. Even in the southwestern desert country, the grass and

desert shrubs were more plentiful and far better developed than they are now.

In the succeeding chapters we noticed that the land has been largely cleared of its forest, that the prairie grasses have long since been plowed under, and that the forage plants of the range country have been seriously damaged by too many head of livestock. Every step has been in the direction of taking off the lush cover that once protected the soil. Instead of grass and trees growing thickly, the soil is continually plowed, stirred up, kept clean of all plants except those we wish to grow.

We have, to be sure, put a partial cover back on the plowed soil. We have planted grains, vegetables, orchards, hay, pasture grasses, and even forest trees. Some of these make a good cover, but some of them make a very poor one. And in so far as cultivated crops are concerned, we have been content to let the soil remain bare all through the winter until we were ready to plant again.

A great many precise measurements have been taken to find out how much soil is lost under different crops. These are not easy to discuss in general terms because the kind of soil and the degree of slope make such a difference. However, two examples may suffice to indicate a generality.

On one soil, 7 inches of topsoil can be washed off in 7 years, if the surface is left entirely bare. If corn is planted on the same soil, it takes 11 years to lose the 7 inches. If the soil is planted to grass, it would take 34,000 years to lose the 7 inches.

On a second kind of soil it would take 18 years to wash away 7 inches, if the soil were bare. With cotton planted on it, the erosion of 7 inches would take 46 years. Under grass 82,000 years would be required, and under forest of the original kind, 575,000 years would have to pass before 7 inches could be washed away. Note that under grass or forest, the topsoil would increase in thickness, since soil would form faster than it would erode.

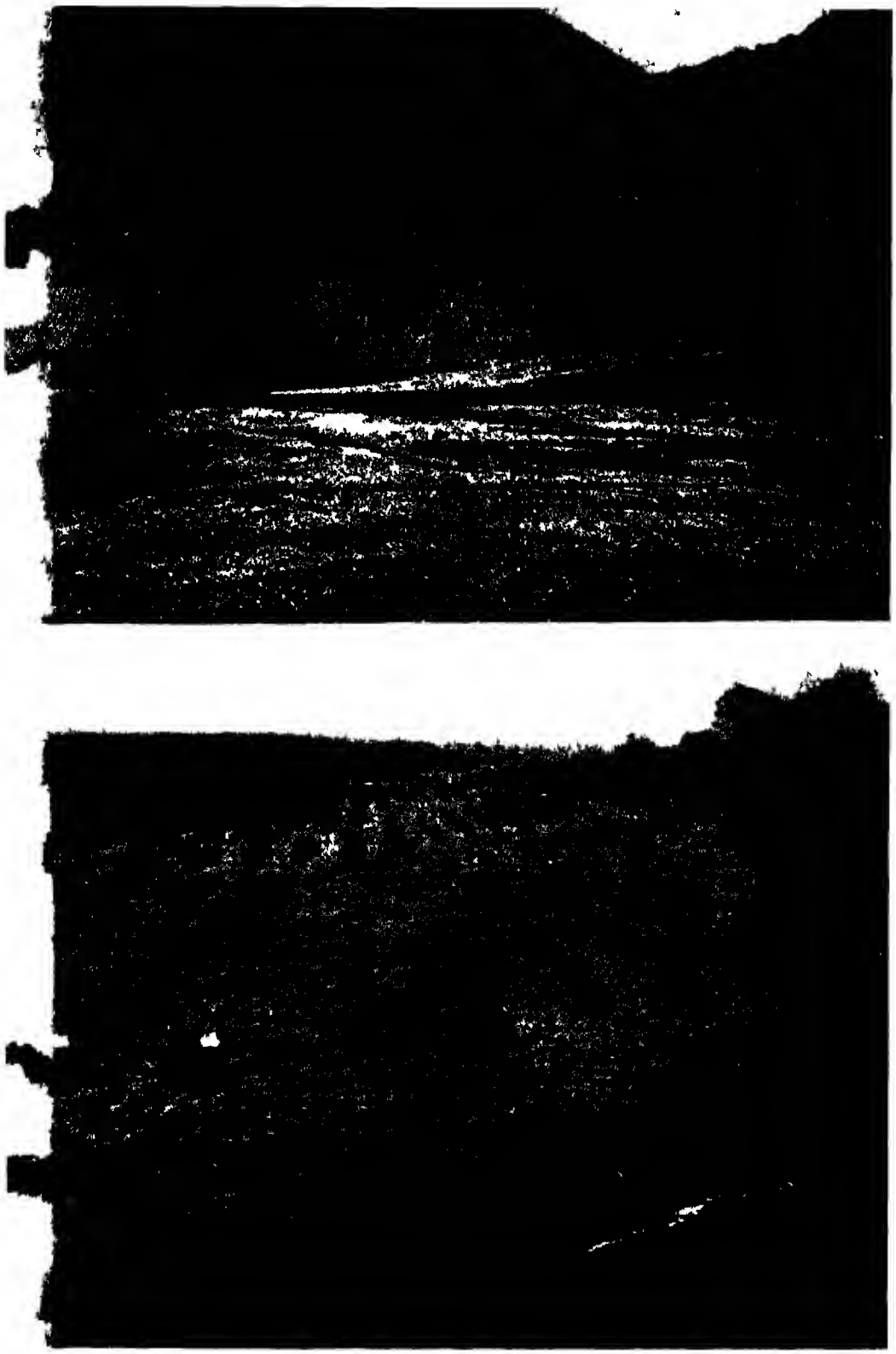

PLATE 57. When soil cover is removed, erosion starts promptly.
BOTTOM Water running off a cornfield carries tons of fine topsoil in suspension.

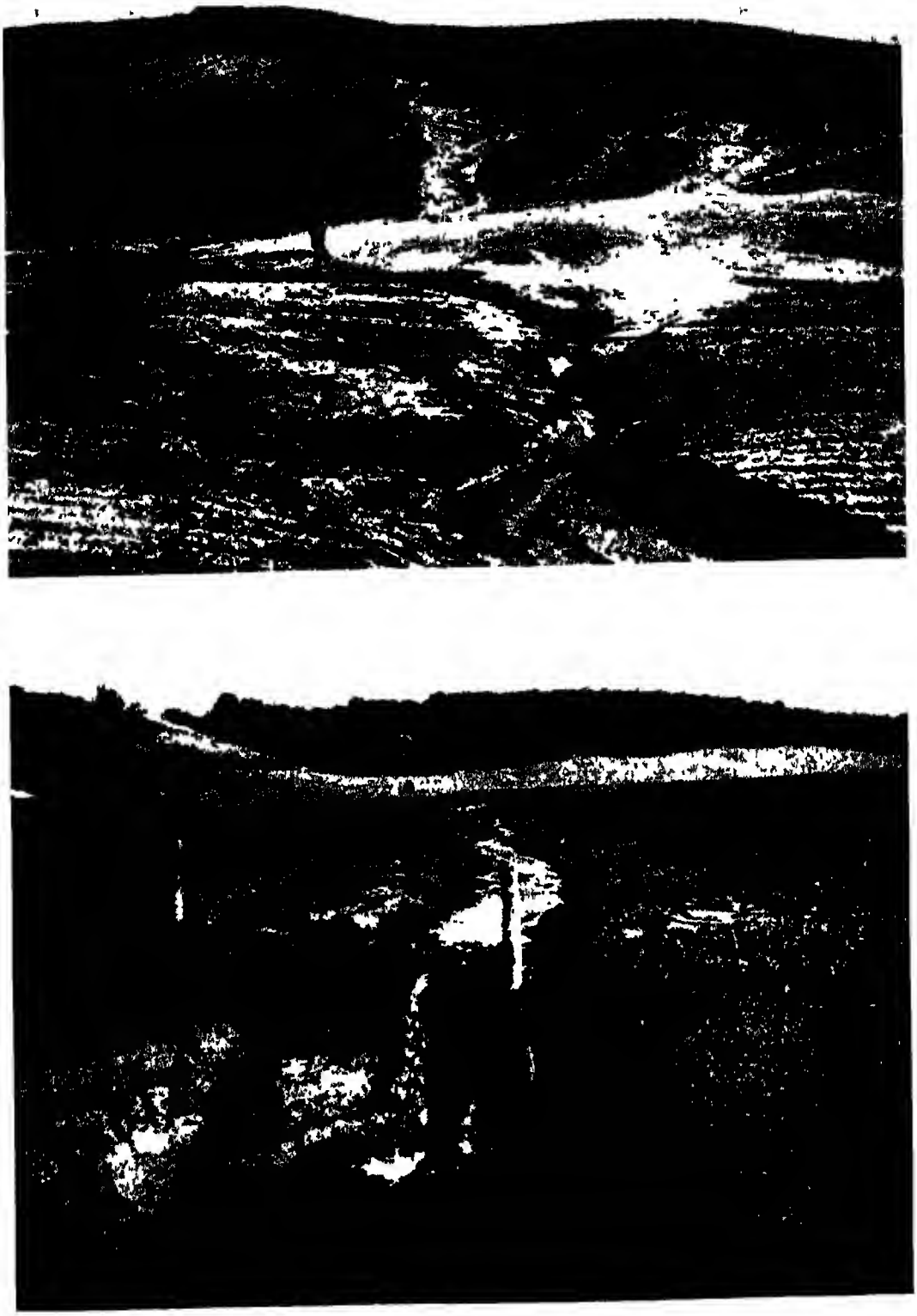

PLATE 58. Unprotected fields lose many tons of soil each rain. Here a gully is beginning to work back into the field.

BOTTOM Water spilling into the gully undercuts the lip; the gully works into the fertile field. This one cut the field half in two before it was stopped.

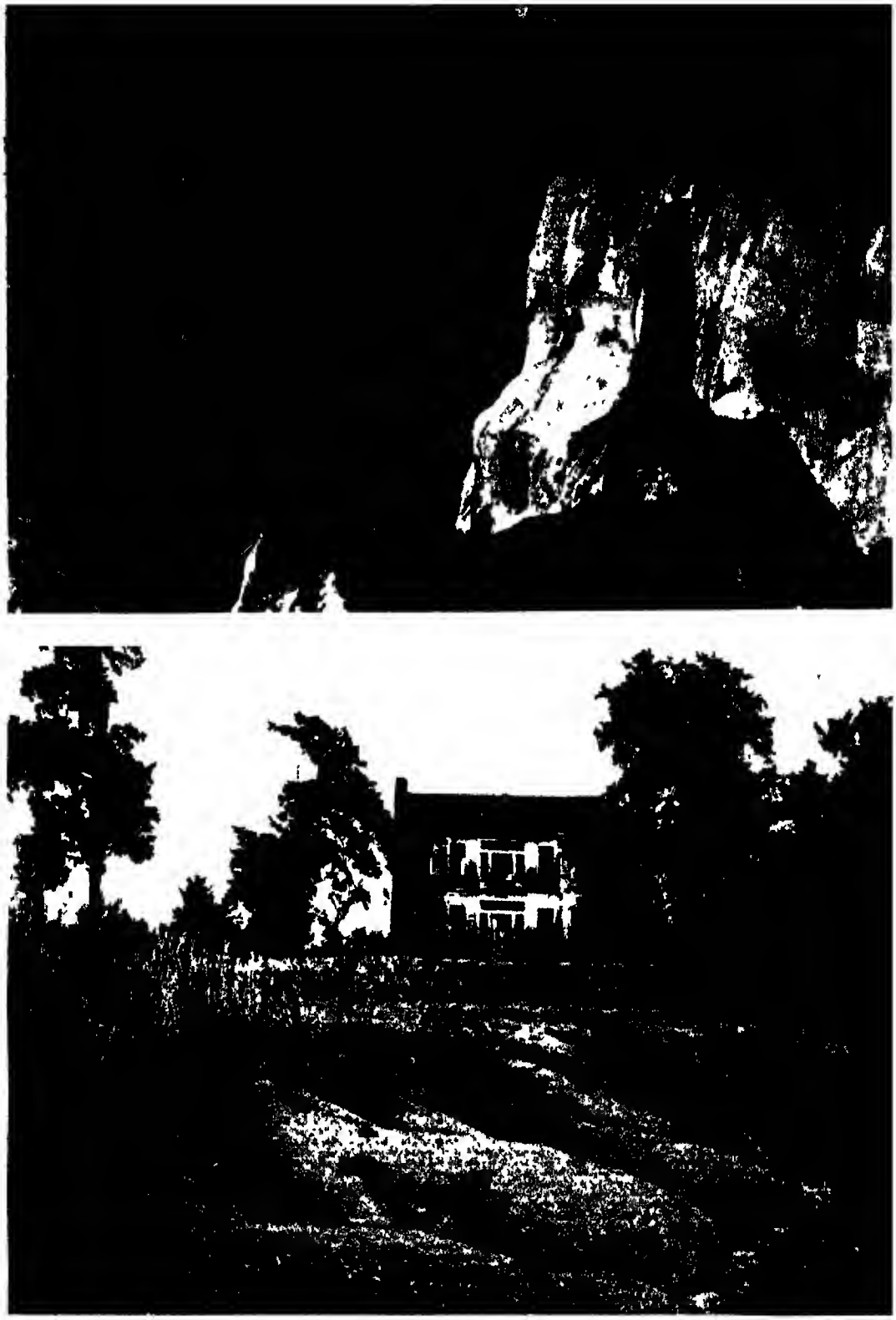

PLATE 59. This chasm is almost 200 feet deep. It was caused by man and was started by unwise farming methods.

BOTTOM. The ultimate situation where land is completely worn out.

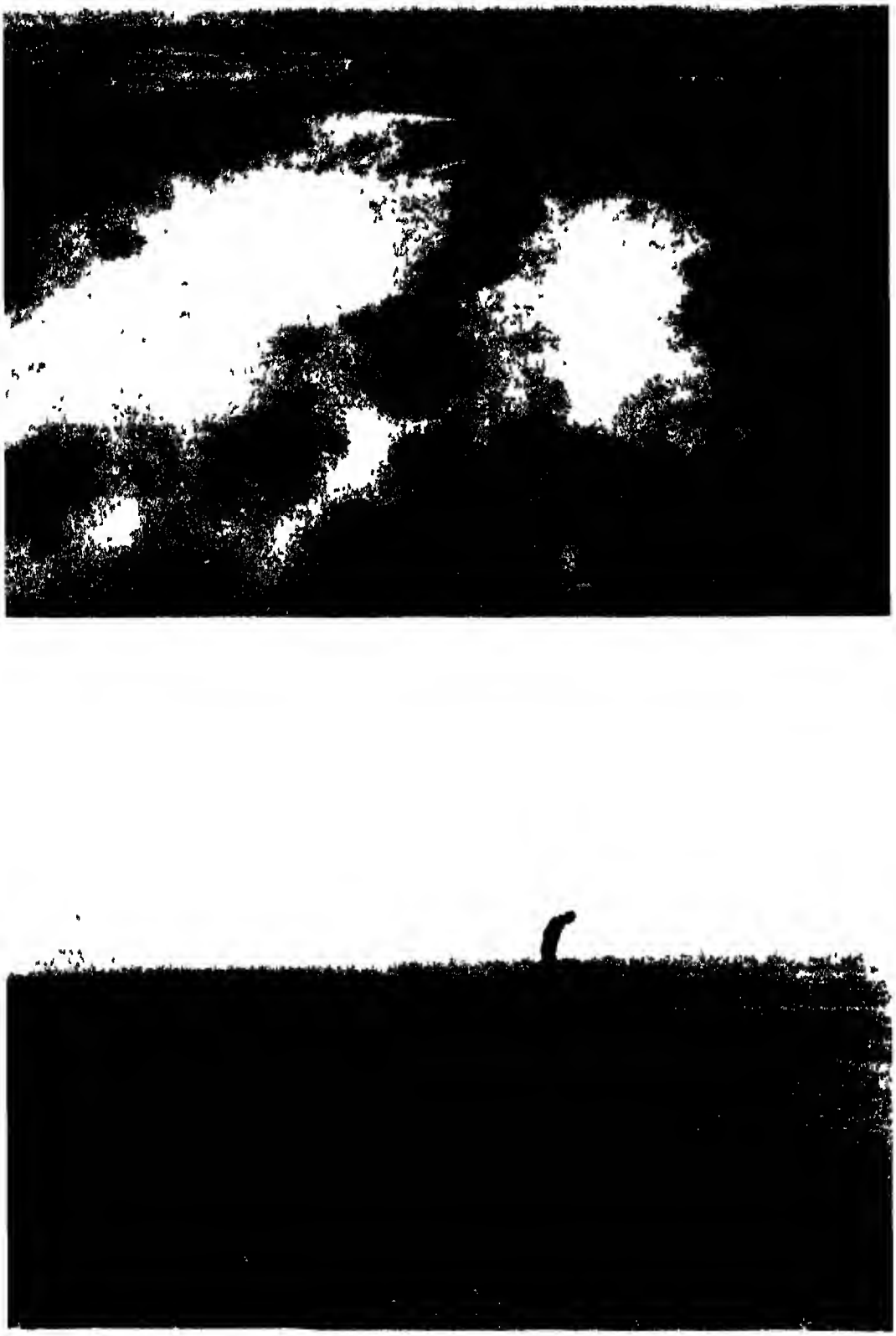

PLATE 60. A young dust storm beginning on dry open fields lacking cover.
BOTTOM. Dust storm in full swing.

PLATE 61. Dust storms may pile sand in dunes, covering good land and rendering it worthless.

BOTTOM. Beans planted and cultivated on the level in contour farming. Erosion is effectively prevented since water cannot run downhill.

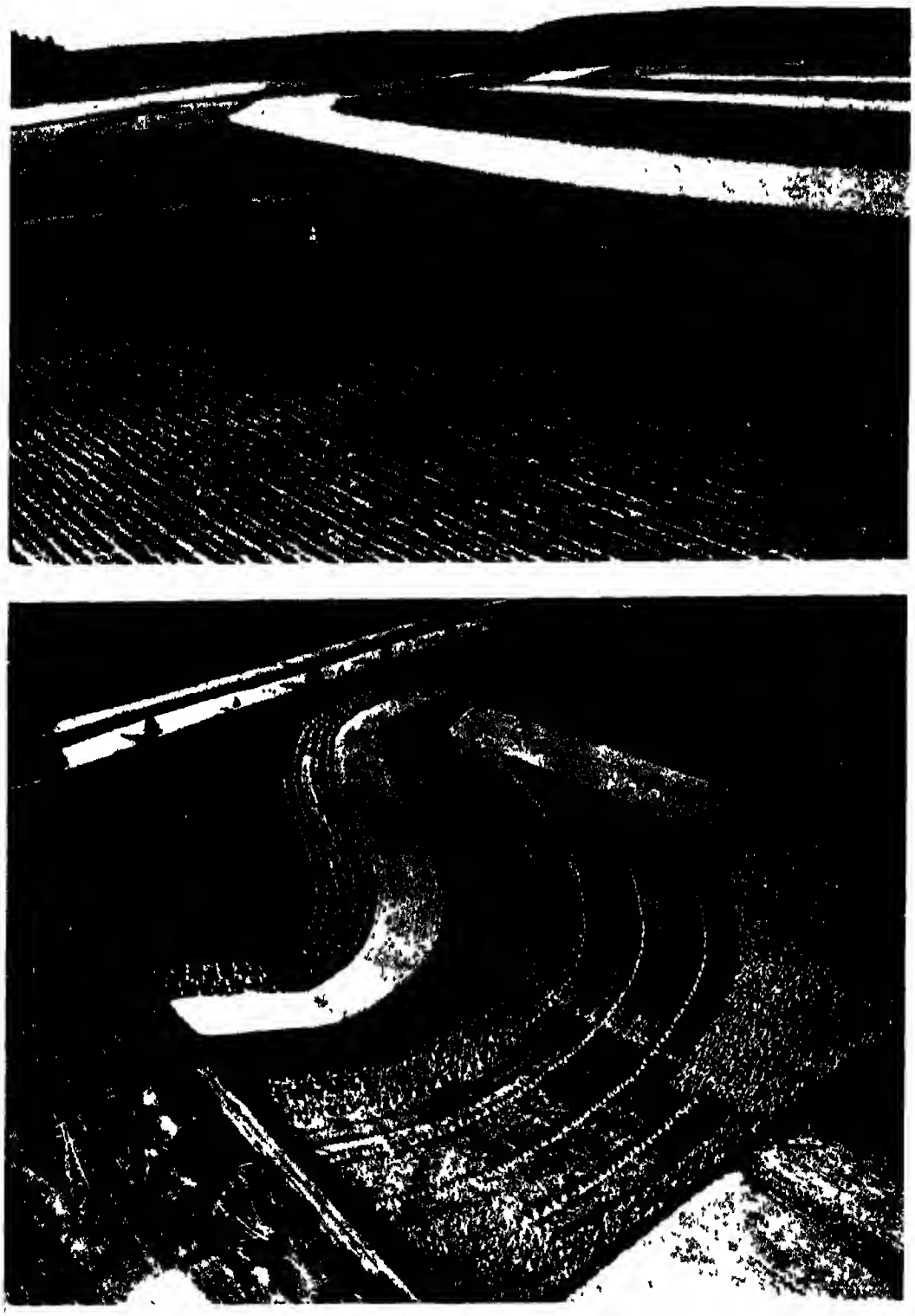

PLATE 62. Strip-cropping in gently sloping Texas lands. Erosion is halted and crop yields increased by these new patterns of land use.

BOTTOM. Aerial view of contour farming. Bands of cultivated crops alternate with close-growing crops that slow downhill rush of water and increase yields.

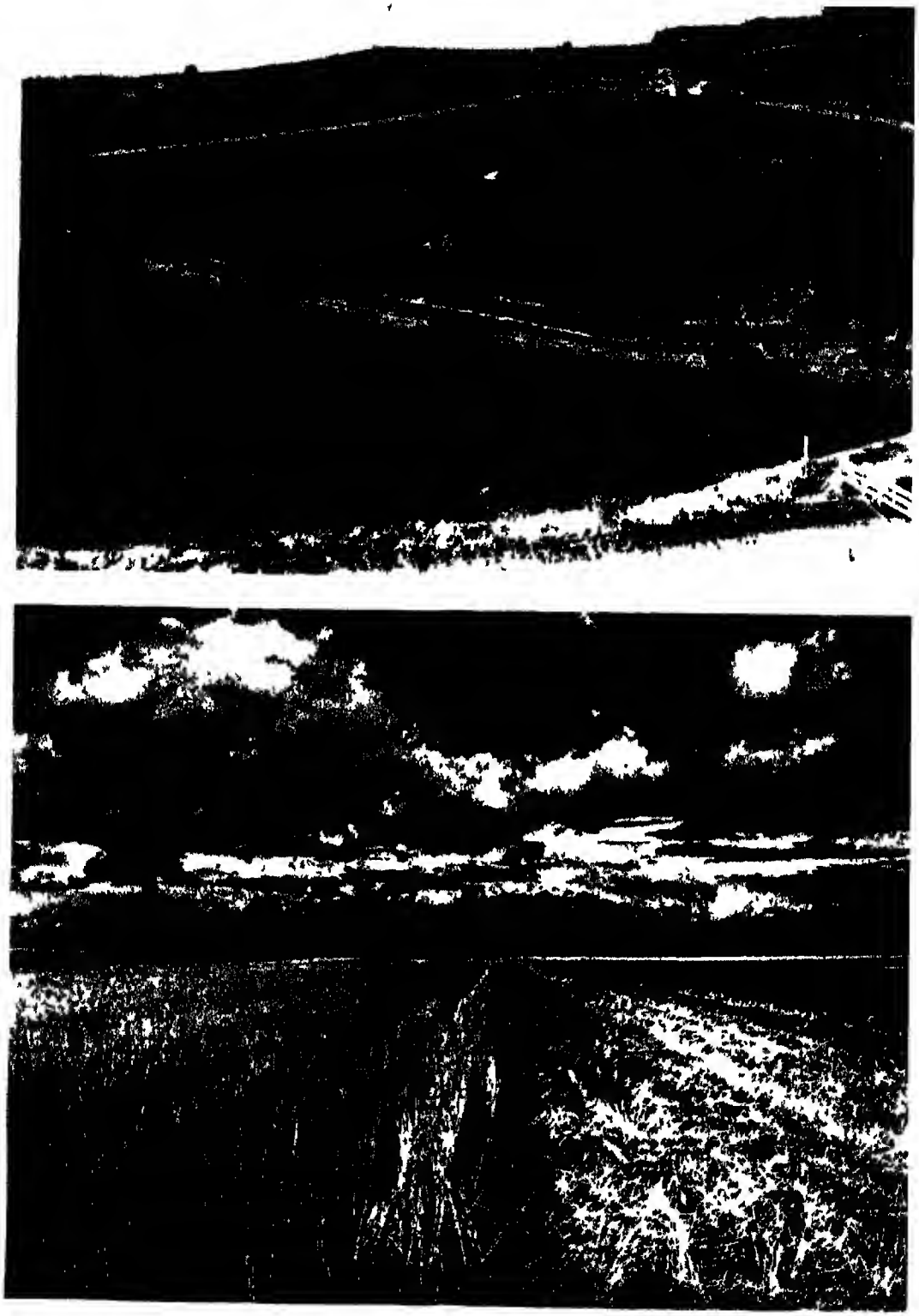

PLATE 63. Terraces on the contour hold back rainwater, delivering it slowly to the outlet in the center.

BOTTOM. Crop residues properly treated leave fields rough and much less susceptible to wind erosion. Rotting straw fertilizes the soil, which increases yields.

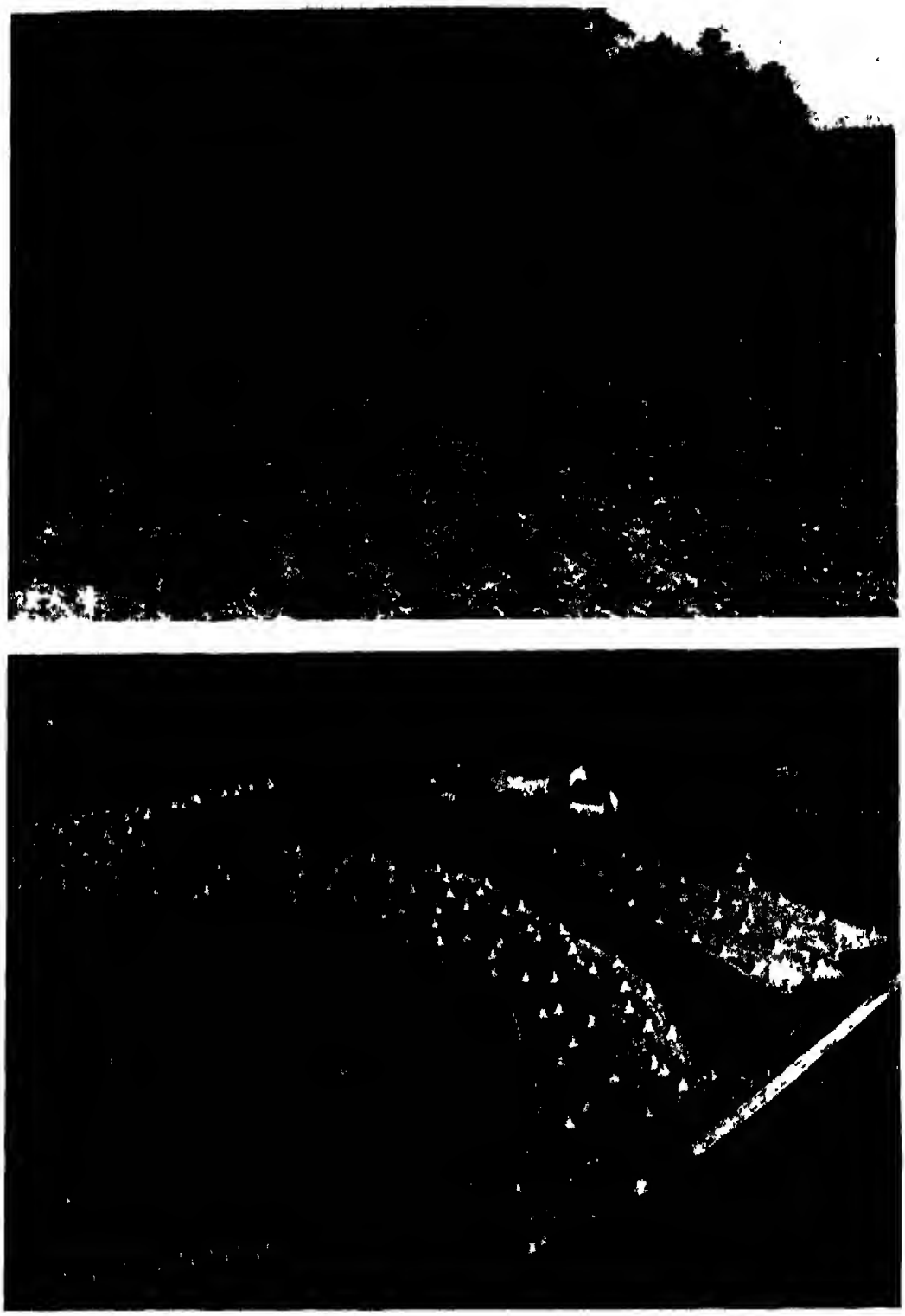

PLATE 64. Border between the woods and cotton crop is planted to a strip of legumes that prevent erosion where crops do poorly and provide cover and food for useful wildlife.

BOTTOM. The new land pattern, fields fitted to the land's contours and best land used for highest-yielding crops, expresses a new era in American thought. (*Photographed by James N. Meyer.*)

Corn, cotton, and tobacco, because they require continued stirring of the soil to keep out weeds, permit erosion to operate very rapidly. 'Erosion-inducing,' these crops have been called. Although they may seem to form a fairly good cover, the land between the rows is bare and the fields they are grown in are bare in the winter. Cultivated crops, generally, permit erosion to go on only a little slower than if the soil were entirely bare.

Crops like wheat, oats, and barley make a better soil cover because they grow closer together than cultivated crops. Even so, fields of wheat can lose a heavy tonnage of soil, so that these grains, although better than cotton or corn, are still not good enough to keep soil in place indefinitely.

Alfalfa is better than the grains as a cover. So are other legumes, such as clover, vetch, sweetclover, kudzu, and lespedeza. Under these legumes erosion is very considerably slower than under cultivated crops.

Under grass, as in pastures, or trees, as in woodland plantations, erosion comes nearly to a stop. If the pastures and woodlands are treated decently, soil may be built up faster than erosion can operate.

Almost 200 years ago in New Jersey, Peter Kalm, a botanist, remarked that a recent rain had washed away great pieces of the ground that had been sown to wheat and rye. Since then erosion has grown with agriculture, sapped its strength, cut at its roots, made it more difficult to practice. In spite of excellent work of crop breeders, many crop yields have remained almost stationary. In spite of better methods of handling most crops, little better harvests per acre are possible than in the beginning. An enormous total area of land has been destroyed, a great deal more is nearly gone, and on almost all our cropland erosion continues to take its toll.

At long last, an alarmed nation began to take steps. 'In another 30 years it might have been too late,' wrote Henry A. Wallace in 1938. 'No man has the right to destroy soil even if he does own it in fee simple . . .' What happened, and how we learned to control erosion, is in the next, and last chapter.

## XVI

# THE NEW LAND PATTERN

For the second time in history a change of new and great significance is taking shape on American land. The first change saw a making over of the original wild landscape into square fields set down every which way to form a patchwork neither skilfully placed nor thoughtfully conceived (Plate 27). We know now that such a pattern as this could never be a lasting one. But once again the pattern is changing, as the face of the land begins to reflect the ways of the people who live upon it. Here is no patchwork, but a broad and subtle handling of slope and soil, sweeping curves and winding terraces, and fields fitted at last to the rounded rolling contours of the land (Plate 64).

It is not much more than a half dozen years since the bold and beautiful designs sketched on the landscape by the new ways of using land have begun to attract widespread attention. It is doubtful whether the new pattern is well understood in its fullest implications, yet it faithfully portrays the ending of one era and the beginning of another. It expresses a profound change in American thought, induced by the realization that this is no longer an expanding nation, but a country whose future security depends upon the ability of its people to use wisely what they have.

'It is now a question,' wrote the Harvard geologist Shaler, 50 years ago, 'whether human culture, which rests upon the uses of the soil, can devise and enforce ways of dealing with the earth which will preserve this source of life so that it may support the men of the ages to come.'

The new land pattern is an important part of the answer to Shaler's pointed, vital question.

## The Beginnings of the Change

It would be difficult to point to this or that person and say that he it was who first conceived the idea of using land as we are coming to use it now. Methods of using land safely and wisely have developed much as crop plants have, through the centuries and in many lands. We know that progressive steps were taken in this country by George Washington and Thomas Jefferson and James Madison, to say nothing of many other farmers whose names are now forgotten. Here and there among the many millions of people who have lived out their lives on the land, first one, then another, noticed things, experimented, and tried new ways. A great many articles have been written, some of them more than a century ago, that tell of simple ways of using land for crops and saving precious topsoil.

Early in the present century various State agricultural experiment stations and the United States Department of Agriculture began studying erosion. A great deal of time was spent learning how erosion operates and how to stop it. The soil and water losses were carefully measured on different kinds of soil, different slopes, under different kinds of crops, different systems of farming. The more the problem was studied, the more people began to realize how important it was. By 1928 there were ten special stations where full-time study was given to erosion and its control. By 1933 enough was known so that something could be done about erosion on American land.

Through the efforts of several federal agencies, notably the Soil Conservation Service, and co-operating farmers, erosion-controlling practices began to be installed. In the beginning the movement was tentative. A few key areas were marked out where the

new way of farming was demonstrated. The few areas increased in numbers; the new way of using land began to spread from these centers into neighboring places. Every time a heavy rain or a driving wind played havoc with soil in neighboring areas, leaving the demonstration farms untouched, applications began to pour in from farmers who wanted *their* land treated in the new way.

Three years after the first demonstration areas were set up, land users everywhere began to demand help so loudly that the program had to be expanded enormously. With the help of proper laws, landowners began setting up districts—soil conservation districts—to practice the new conservation farming. The movement spread, and is still spreading, nor is it likely that there will ever be a return to old systems or to old patterns (Plate 64).

## The Outward Evidences

Probably the most important soil-conservation practice, and one basic to the successful operation of erosion control in many areas, is contour cultivation. For many years in this country, farmers took pride in their ability to plow in a straight line—which was all very well as long as the land was level. But when these lovely straight furrows began going up and down hill, they furnished excellent channels for water. When it rained, water took the shortest course downhill, through the plow furrows that were, so to speak, made to order. Naturally, the steeper the hill, the faster the water raced down these furrows, picking up soil as it went.

The obvious way to make plow furrows so that water could not flow down them, was to plow across the slope. If this were done, every furrow would act as a barrier instead of a convenience. But to do this, the furrows would have to be plowed so that they are *always exactly at right angles* to the slope, and in carrying out this idea, farmers found themselves curving in and out on slopes, plowing furrows that were by no means straight. Instead of running up

and down hill, they ran *around* the hills. And since land is usually pretty variable in its topography, the furrows curved in and then out of the little hollows, and out and in again on the bulges or ridges (Plate 61).

Interestingly enough, farmers found that by following the land's contours in this manner, they did not have to work as hard. Obviously it is easier to walk and work on the level than up hill or down hill. And what is possibly of more importance when you make your living by farming, you do not need as many horses, nor does your tractor use as much gasoline. Farmers found out early in the game that the new contour cultivation was not only a soil saver, but a labor saver as well. The tradition of the straight furrow, in other words, began to give way to a new tradition of the level furrow, a concept not only scientifically correct but based on common sense.

*Strip-Cropping.* Of all the conservation farming methods, the arrangement of crops in ribbons or bands—on the contour—is the most likely to attract attention (Plate 62). The theory behind the practice of farming in strips is rather simple, although the effect on the landscape often seems rather remarkable. What it amounts to is that some crops—such as corn—do not stop much soil from washing, as we noted in the last chapter. Other crops—such as grass or clover—will do a much better job. By alternating strips of corn with strips of grass, erosion is reduced very considerably. Water may start to run downhill, even where the land is cultivated on the contour, in the strips of corn. But when it runs into the grass strip, it slows down, drops most of its soil, and has a chance to soak into the ground.

Strip-cropping does not stop all erosion, but it stops a great deal. The experts on soil conservation can tell you of some interesting problems connected with it. For one thing, how wide the strips should be, on different slopes and soils, requires a good bit of ex-

perimenting. If the corn strips are too wide, the water may get such a good start that it flows right over the grass strip, tears into the next corn strip, and begins to cut away soil at a great rate. If the grass strip is too wide, the farmer may not be able to grow as much corn as he needs. But these problems are fairly well worked out for different parts of the country. If you notice little gullies in a strip-cropped field, rely upon it that the width of the strips will be changed next year.

*Terraces.* Terraces mean different things to different people, which is one way of saying that there are many kinds of terraces. One kind is the type the Incas, Chinese, and Babylonians used in mountainous country. Essentially they made steps on the slopes, cultivating crops on the level portion, and perhaps building stone walls on the vertical parts. We use such terraces in this country in California, where we call them bench terraces. The chances are good that they will come into greater use in other parts of the country, especially in the Southeast, where they are already in evidence in some places.

But there is another kind of terrace that is far more common in the United States. Essentially this type is a low ridge that winds along on the land's contours, presenting a formidable barrier to any water flowing downhill (Plate 63). Some are exactly on the level, but most of them have a very slight gradient downward. The idea is not only to stop the water from running directly downhill, but also to conduct it slowly off the land, if it does not soak in.

Quite a little expert engineering is involved in making terraces. They must not have too much 'drop': that is, if they let the water run too fast, a gully may develop along the uphill side of the terrace. If they are too nearly level, the water may fill them and, during hard rains, break over the top. Terraces must empty somewhere, and where they do, carefully designed outlets must be built, otherwise a gully may start that will eat back into the terrace itself.

Also, terraces must be made so that farm machinery can work on them without tipping over. In places this means that the terraces must have a very gentle roll, so gentle that you may not be able to detect them at first glance. Mangum terraces, these are called. Where land is steep, and the soil is right, a terrace may look like an oversize plow furrow, with a ditch on the uphill side, and a steep-sloped ridge running alongside. Terraces of this type cannot be farmed; they go by the name of diversion terraces.

Terraces are not in themselves sufficient to control all erosion. They are most useful when combined with strip-cropping and various other conservation practices. Needless to say, they must be combined with contour cultivation. If they are not, in the long run they only make things worse. Terrace outlets must be well made so that they can carry water to the nearest stream without permitting any erosion. In California terrace outlets may be concrete or asphalt flumes, but in most places the outlets are fairly broad artificial waterways planted with a thick grass sod. You can often see these sweeping waterways running downhill through strip crops, with terraces emptying into them from one or both sides.

*Crop Residue Mulches.* Wherever crops are harvested so that the land is left without any cover on it at all, erosion works on it until a new crop is planted. If the crop is harvested so as to leave a residue of material on the soil, erosion does much less damage. Sometimes the crop may be harvested clean, then after the grains or seeds are extracted, the residue of the plants may be hauled out and spread on the field. In wheat country the wheat is cut off high enough to leave a healthy stubble. This is plowed with a special plow so that part of the stubble is buried and part is left sticking up from the soil (Plate 63). Such a use of residue pays dividends, especially where wind erosion is severe.

*Less Obvious Practices.* Besides the conservation practices noted

above, that are easy to distinguish on the land, there are many more that are not as easy to see, but that are equally important. Instead of crop residues, cover crops of legumes or winter grains may be planted in the fall to protect soil over winter. Crop rotations are used to increase the value of strip-cropping. Each year the strips are changed so that a strip that had corn on it one year has a legume the next, and vice versa. By rotating the crops in this way, every other year a good dose of 'green manure' is added to each strip. And the more organic material there is in soil, the more water it can absorb, and the better crops it can produce.

On range and pasture land the conservation practices are aimed at keeping the grass or other pasture plants in good condition, even under grazing. Lime and fertilizers are applied to pastures to make the plants grow better. Cattle are taken off pastures that show signs of being overgrazed, and kept on pastures that are in better shape —rotation grazing, this is called. Careful attention is paid to the numbers of animals released on the range or pasture to insure having enough—but no more—animals to use up available forage. Sometimes furrows on the contour are plowed at intervals, in pastures, to cut down water losses. On the range, riders keep livestock on the move so that the animals will not, so to speak, eat themselves out of food. Water holes and salt licks are developed at strategic points so that livestock will spread out evenly over the range. All these practices can be detected if you look for them. If the pastures and range are overgrazed, conservation farming is not being practiced.

Land that is altogether too steep for ordinary crops, or that is already gullied and worn by erosion, is planted to trees and shrubs, both to grow wood and to foster the production of game and fur animals. Stream-banks are closely protected from grazing animals so that the vegetation may save the banks from the cutting action of the stream. Field borders and edges of woodlands are planted

to shrubs, grasses, or legumes that protect the unproductive edges and provide food and cover for wildlife (Plate 64).

The most important principle of all, one that can easily be seen in operation, yet go unrecognized, we come now to discuss.

## Land Capability

In the chapter on corn we noted that on some land you can grow no more than 25 bushels of corn on an acre. With the same seed, fertilizer, and cultivation, you can grow 100 bushels on an acre of really first-class land. This is the same thing as saying that with this same effort, you can grow four times as much corn on an acre of good land as you can on an acre of poor land. From this it would seem sensible to grow corn on land capable of producing large yields and to grow some other, less valuable crop on lower-class land. But there is more to this than may appear at first sight.

If, in growing corn on our high-class acre, we find that erosion depletes the soil so rapidly that we get less and less corn each year, then obviously it is not sensible to keep on using the land for corn without some kind of safeguard, for in a short while our acre would be worn out. The soil, let us suppose, erodes very easily; the acre lies on a hillside where running water washes rapidly and gullies start with every rain. Therefore, we cannot say that we have a piece of really first-class corn land unless we say also that we will use it in such a way as to keep it in first-class condition. Depending on its slope, kind of soil, susceptibility to erosion, and a number of other things, we may need to use contour cultivation, practice crop rotation, employ terracing, or use any one of a number of other conservation practices, alone or in combination.

It is possible to classify land by making use of these general principles. First-class land might well be the level, fertile land that will keep on producing indefinitely under ordinary farming methods. The second class might include land equally fertile but slop-

ing, and on this class of land we would need to cultivate on the contour in order to prevent washing of soil. Steeper land would require more complex practices, such as terracing or strip-cropping, to protect them from erosion, and this land could be put in still another class. Extremely steep land with dangerously erosive soil would have to be kept in some kind of permanent cover, such as hay, pasture, or woodland.

Soil conservation experts have, in fact, classified land in just such a manner. They have divided land into eight classes beginning with Class I—our level, fertile land requiring no conservation practices—and ending with Class VIII, land that requires the greatest care to avoid losing it altogether. These classes of land are called Land Capability Classes, and they are of very great value and importance as a basis for the use of land.

Land capability maps have been made for many parts of the United States. From them you can determine which crops are safe for any piece of land, and what conservation practices must be used to keep the land in condition for permanent use. Once each piece of land is used as it should be, once *all* American land is treated according to its capabilities, then America may outproduce anything it has ever done before.

Whether you are a farmer or not, you have an interest in the land, no matter who is using it. If it is being used wisely, you and your children may have enough to eat; if it is being wasted, one of these days future Americans may go on shorter rations. That is why the Government of the United States is very much interested in getting people to use land properly.

To use land so that the best of it is devoted to high-yielding crops and so that it does not wash or blow away seems like common sense. But as we saw in the last chapter, land users seem to have forgotten that land can be destroyed. It is only in recent

years that common sense has begun to get the upper hand, a barely in time at that.

## Results of the New Agriculture

Strangely enough, although the new land-changing agricult was developed to save soil, it has produced some other results t have astonished even those most familiar with it. As the lan given better cover and treatment, it responds by producing m more bountifully than before. In Texas wheat country, when c servation farming is applied, it takes only two-thirds as much l to produce the same amount of wheat as grown before. Cot yields have increased by a third—on the same land—with pro practices. In various places other heartening increases have b measured—beans up nearly 50 per cent in New Mexico, sorgh 56 per cent better in Texas, potatoes 8 to 23 bushels more per a in New Jersey, grapes 80 per cent better in New York. In Illin two acres of the poorest land treated with proper conservat practices produce as much as one acre of the very best with them. If contour cultivation could be applied to no more tha third of the land in the Corn Belt, according to research scient of the Department of Agriculture, the annual production of c could be increased by 100 million bushels a year.

We need to bear in mind that conservation farming alone is n responsible for these remarkable harvest increases. Plant breed as we have noticed in earlier chapters, have done wonders w many crop plants, increasing their yield many times. But eroded soils, deficient in plant foods, the new, higher-yield strains have only served to keep yields at about the same level before. Once the soil is decently treated, the magnificent effo of plant breeders can—and do—begin to show themselves, a harvests become more bountiful.

## The Changing Face of the Land

It has been truly said that mankind moves forward only through a series of blunders and failures and mistakes. So it has been in America, and so it will be, no doubt. More than three centuries have passed by while the frontier moved westward across America —and disappeared. During those 300 years it seemed as though the resources of this vast country were unlimited, and that the expanding frontier would always serve to furnish us with new and virgin land. From the incredibly fertile soils of America we have taken wealth beyond reckoning, and almost, but not quite, we have succeeded in destroying the soil on which our way of life depends.

Once again the pattern of land use is changing because we learned that our first efforts were seriously unwise. It may be that centuries from now an enlightened America may smile at our present strivings and at our bold new pattern. But for the moment there is every sound reason for the hope that this time the pattern is a lasting one.

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